UNIVERSITY OF GHANA

GENDER AND CLIMATE CHANGE ADAPTATION STRATEGIES IN TOLON DISTRICT IN THE NORTHERN REGION OF GHANA

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THIS THESIS IS SUBMITTED TO THE UNIVERSITY OF GHANA, LEGON IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF MPHIL. GEOGRAPHY DEGREE.

JULY, 2016
DECLARATION

I hereby declare that this project work is my own work towards the award of second degree and that, to the best of my knowledge, it contains no material previously published by another person or material which has been accepted for the award of any other degree by the University or any other University, except where due acknowledgment has been made in the context.

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(SUPERVISOR) SIGNATURE DATE

DR. ADELINA MENSACH ........................................... ........................................
(SUPERVISOR) SIGNATURE DATE
DEDICATION

This piece of work is dedicated to my parents, Hajia and Alhaji Abubakari Atibilla, for being my pillar and support throughout my education despite the ups and downs. The work is also dedicated especially to Hajia Mariyam for her immense prayers and encouraging words. Also, to my dear siblings for their consistent support and prayers towards the successful completion of this work.
ACKNOWLEDGEMENT

I thank Almighty Allah for seeing me through to the completion of this piece of work, and making my education a dream come true. I wish to express my profound gratitude to Dr. Charlotte Wrigley-Asante and Dr. Adelina Mensah my supervisors for their guidance through the entire project work. I am grateful to Mr. Prosper Adiku for encouraging me and reading through my work. I also thank Mr. Godwin Odikro for helping me in the re-organization of this work. Finally, I wish to express my profound gratitude to my research assistant Mr. Abdallah Mohammed for his immense contribution during my data collection and all friends and colleagues who in diverse ways have contributed to the success of this work.

Special gratitude to all my respondents who made time out of their busy schedules for the interviews conducted.

May Allah (S.W.A) richly bless you all
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<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>AR5</td>
<td>Fifth Assessment Report</td>
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<tr>
<td>BURs</td>
<td>Biennial Update Reports</td>
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<tr>
<td>CA</td>
<td>Conservation Agriculture</td>
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<tr>
<td>CCAFS</td>
<td>Climate Change, Agriculture and Food Security</td>
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<td>CDWR</td>
<td>California Department of Water Resources</td>
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<td>CSA</td>
<td>Climate Smart Agriculture</td>
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<tr>
<td>CW</td>
<td>Change in Weather</td>
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<tr>
<td>DECLG</td>
<td>Department of Environment Community and Local Government</td>
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<tr>
<td>DFID</td>
<td>Department for International Development</td>
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<tr>
<td>FASDEP</td>
<td>Food and Agriculture Sector Development Policy</td>
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<td>FDG</td>
<td>Focus Group Discussion</td>
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<td>FAO</td>
<td>Food and Agricultural Organization</td>
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<td>GDP</td>
<td>Gross Domestic Product</td>
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<tr>
<td>GPS</td>
<td>Global Positioning System</td>
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<td>IFRC</td>
<td>International Federation of the Red Cross and Red Crescent Societies</td>
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<td>iNDCs</td>
<td>intended National Determined Contributions</td>
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<tr>
<td>IPCC</td>
<td>Intergovernmental Panel on Climate Change</td>
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<td>IPCC TAR</td>
<td>Intergovernmental Panel on Climate Change/Third Assessment Report</td>
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<tr>
<td>IRADe</td>
<td>Integrated Research and Action for Development</td>
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<tr>
<td>MDAs</td>
<td>Ministries, Departments and Agencies</td>
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<td>MDGs</td>
<td>Millennium Development Goals</td>
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<tr>
<td>MEST</td>
<td>Matter Energy Space and Time</td>
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<tr>
<td>MESTI</td>
<td>Ministry of Environment Science Technology and Innovation</td>
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<td>MoFA</td>
<td>Ministry of Foreign Affairs</td>
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<tr>
<td>NAPAs</td>
<td>National Adaptation Plans of Action</td>
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<td>NAPs</td>
<td>National Adaptation Plans</td>
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<td>NCCP</td>
<td>National Climate Change Policy</td>
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<tr>
<td>NCs</td>
<td>National Communications</td>
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<tr>
<td>Acronym</td>
<td>Full Form</td>
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<tr>
<td>NGO</td>
<td>Non-Covernment Organisation</td>
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<tr>
<td>OECD</td>
<td>Organization for Economic Cooperation and Development</td>
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<tr>
<td>PNDC</td>
<td>Provisional National Defence Council</td>
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<tr>
<td>UN</td>
<td>United Nation</td>
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<td>UNDP</td>
<td>United Nations Development Programme</td>
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<td>UNEFPA</td>
<td>United Nations Fund for Population Activities</td>
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<td>UNEP</td>
<td>United Nations Environment Program</td>
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<tr>
<td>UNESCO</td>
<td>United Nations Educational, Scientific and Cultural Organization</td>
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<tr>
<td>UNFCCC</td>
<td>United Nation Framework Convention on Climate Change</td>
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<tr>
<td>UN-REDD</td>
<td>Reducing Emissions from Deforestation and Forest Degradation</td>
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<tr>
<td>WEDO</td>
<td>Women Environment Development Organization</td>
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ABSTRACT

Changes in climate introduce numerous uncertainties to the livelihoods of farming communities that rely on the weather and climate. Climate change impacts are being felt in Ghana, most especially in the savanna zones, due in part to the geographical conditions of the location affecting both human and physical resources. This study assessed female and male adaptation strategies to climate change and its effects on their livelihoods in six communities in the Tolon District of the Northern Region.

The study used a mixed method strategy to obtain quantitative and qualitative data. Statistical Package for Social Sciences (SPSS v.20) and Microsoft Excel was used for analyzing quantitative data. The study administered 250 questionnaires to six selected host communities (100 female and 150 male household heads). A total of nine Focus Group Discussion (FGDs) with female, male and youth groups were carried out in three of the study communities. Factor analysis was used as a statistical tool in investigating how the farmers assessed the impacts of adopted adaptation strategies on the physical environment.

The results from the study show that the level of awareness on climate change is very high in the study area, with 100% and 94% female respondents similarly showed high awareness. Furthermore, reducing precipitation (Climate Change Effects) has impacted on the livelihoods of the people as they experience declines in both crop and livestock production. This further affects the households as 97% female and 98% male household heads indicate that the changes have brought about an increase in hunger and food insecurity. The study also show that farmers in the six communities have adopted various adaptation strategies in which the most effectively used strategy is fertilizer application and the least is alternative livelihoods. Again, soil conservation, obtaining information, reduction in crop production, soil conservation, planting trees, early and late planting, changing how harvest is managed and increasing fertilizer use variously affects the physical environment. The study
recommends that extension officers and Ministries, Departments and Agencies (MDAs) should sustain awareness creation on climate change, monitor and ensure easy access to inputs such as fertilizers and ploughs, governments should provide local adaptation strategies at the local level to support livelihoods and also protect the environment. Finally, the study recommends the enactment of bye laws by the MDAs to protect environmental resources such as tree planting, water conservation and soil conservation.
CHAPTER ONE
INTRODUCTION

1.1 Background

The Intergovernmental Panel on Climate Change (IPCC) defines climate change as any change in climate over a 30 year period, whether due to natural variability or as a result of human activity (IPCC, 2007). The United Nation Framework Convention on Climate Change (UNFCCC) defines climate change as a change of climate attributed directly or indirectly to human activities that alter the composition of the global atmosphere and which are in addition to natural climatic variability, observed over comparable time periods (UNFCCC, 2011).

Climate is a natural phenomenon that has always been dynamic and varies at a global scale in time and space (Koutsoyiannis, 2003). The current concern for climate change has arisen because of the unprecedented human industrial and development activities of the past two decades that have caused changes over and above natural variation (IPCC, 2013). The release of large volumes of greenhouse gases (GHGs) into the atmosphere as a result of the burning of fossil fuels is one important source of human-induced climate change (Hansen et al., 2008). Climate change is now a scientifically proven phenomenon that poses serious consequences for humans and ecosystems (Vitousek et al., 2008).

It is generally accepted that the estimated increase in the climatic atmospheric concentration of climate change related GHGs will adjust the scale of seasonal variations of precipitation pattern and temperature in many parts of the world (IPCC, 2007; Ozdogean, 2011; Al-Amin and Filho, 2014). Further emissions of greenhouse gases will cause temperature to increase by 1.5°C to 5.8°C and precipitation patterns to shift by 2100 (Houghton et al., 2001; Mendolsohn et al., 2006). As indicated by the Fifth Assessment Report (AR5) of the IPCC Working Group 1, constant release of greenhouse gases will cause further warming and
changes in all components of the climate system. This will require extensive reductions of the emissions. The direct impacts of climate change and global warming include the destruction of natural resources and the agro-economy; loss of life; migration leading to human resettlements; damage of infrastructure, the economy and the environment. The indirect impacts on human health, food security among others, seem to be much more frequently reported (and are well noted in recent scientific literatures including Ahmed et al. (2011), Georgescu et al. (2011), Lobell et al. (2008) and Stern (2007)).

Africa has been described as one of the most vulnerable regions to the effects of global climate change. This is the result of the lack of or low adaptive capacity to increases in extreme events due to widespread poverty, heavy reliance on rain-fed agriculture, lack of economic and technological resources, and insufficient safety nets and educational progress (IPCC, 2001; Davidson et al., 2003; Reid and Vogel, 2006). While many African societies have been exposed to climate variability for a long time and have developed adaptive strategies in response (Smith, 2006) some argue that Africa is already close to the limit of her coping ability (Sokona and Denton, 2001).

In a climatic event, communities and regions will be exposed to the same changing temperatures and precipitation; however, the ways in which they are vulnerable to these changes will vary greatly (Babuguru et al., 2010). It has been noted that the impact of climate variability and change on the rural poor has become more pronounced with the passing years (Jonson, 2011). The patterns of vulnerability to climate change impacts are shaped by social factors ranging from gender roles, class and ethnicity. For example, women in developing countries, who are often dependent on natural resources (such as firewood, forest products, and water), are often disproportionately affected by environmental degradation (Valarie et al.,
These social factors have broad consequences on the ways in which people experience and address the impacts of climate variability and change (Carr et al., 2014). The commonest form of response to the effects of the changing climates has been through adaptation, which includes adjustments in ecological, social, or economic systems as a consequence of occurring or expected climatic stimuli and their effects or impacts. Adaptation also includes changes in processes, practices and structures to moderate potential damage or harness benefits from opportunities associated with climatic change (Burton et al., 2000). Currently, adaptation to climate change has become a major concern to farmers, researchers and policy makers. Bryant et al. (2000) reported that adaptation in agriculture is how perception in climate change is translated into agricultural decision-making. Adaptation is more preferable as a response strategy compared to its counterpart mitigation because adaptation requires shorter time scales to produce desirable outcomes.

In Ghana, severe ecological, economic and social impacts are beginning to emerge as evidence from 1961-2000 meteorological data show an increase in temperature and a decrease in annual rainfall across all the ecological zones. The most significant impacts are due to the incidence of weather extremes (e.g. high temperatures, declining rainfall and increased variability in rainfall patterns) and disasters (e.g. floods and drought). The impacts are particularly pronounced among rural farmers whose livelihoods depend largely on rain-fed and small-scale agriculture, which serve as the backbone of the country’s economy. Agriculture contributes about 35% to Ghana’s GDP, generating about 30-40% of foreign exchange earnings and employs about 55% of the population (MoFA, 2010). The sector is confronted by many factors including climate-related disasters like drought, and floods especially in the northern parts of the country.
Gender dimensions to climate change have also sparked considerable debate in both local and international domains since the mid-1980s. Gender perspectives have arisen because men and women have different levels of vulnerability as a result of inequalities and differences in roles and position, power and resources in responding to the impacts of climate change (Babuguru, 2010; WEDO, 2007; Commission on the sector of Women, 2008; Carvajal et al., 2008; BRIDGE, 2008). Patrick and Denton (2003) noted that, climate change is manifested in the extreme weather conditions such as hot summer, drought among others impact women more than men.

1.2 Problem Statement
Changes in climate introduces numerous uncertainties to the livelihoods of farming communities that rely heavily on the weather and climate (Al-Hassan and Poulton, 2009; Athula and Scarborough, 2011). Climate change impinges on land-use and livestock management by changing crop forage, livestock growth and yield (Mu and McCarl, 2011). Interconnected events such as erratic rainfall, longer drought periods and floods accumulate in terms of both severity and incidence in Africa (FAO, 2008; IPCC, 2014)). Such events have been creating natural hazards and resulted in unfavorable impacts on smallholder farmers’ livelihoods (Yaro, 2002; Hesselberg and Yaro, 2006; Akudugu, 2012). According to Bartlett (2008) and Rohr (2007) the effects of natural hazards such as climate change have varied effects on the lives and livelihoods of both men and women and this ascribed to the roles society places on men and women (UNDP, 2007). Smallholder farmers in Africa need to overcome the barriers of adaptation to climate change and variability in order to make more significant contribution to a green economy (Bediane, 2012)

Studies on gender and climate change (Aquilar, 2004; WEDO, 2008; Chowdhury et al., 1993; Skutch, 2004; Neumayer & Plumper, 2007; Pruss-Ustun et al., 2008) allude to the fact that
socially constructed roles determine the different effects of climate change on female and male. The National Climate Change Policy (2013) outlined three key objectives for its policy which include effective adaptation, social development and mitigation. Tackling the threats of climate change therefore is a national priority and adaptation a key strategy to minimizing vulnerabilities to climate change. The IPCC, Fifth Assessment Report on the impact of adaptation and vulnerability of climate change in African States noted that “African ecosystems are already being affected by climate change and future impacts are expected to be substantial” (IPCC, 2014 p3).

The northern region of Ghana has been identified as one of the most vulnerable areas in the country due to its geographical location. Smallholder farmers have therefore been modifying their practices to better adapt using several technologies and practices. Although, the diversification of the production and migration were traditionally the prime means of adaptation, many farmers have begun to intensify their production by adopting shallow groundwater irrigation for vegetable gardening for Ghana’s urban markets (Laube, 2012).

The Tolon District, like many others in other parts of the Northern region has been plagued by drought which has markedly affected livelihoods including gender roles (Tschakert et al., 2013). A number of studies have examined the impact of climate change in the district (e.g., Nelson and Agbey, 2005). Adaptive strategies adopted by local people (e.g., Musah & Abayomi, 2013), and how effectively its usage has mitigated the impact of climate change (Antwi et al., 2014). There is however inadequate information on the gender differentiated adaptation strategies and how these strategies effectively impact on the livelihoods of farmers. It is against this backdrop that this research is being carried out to fill this gap in literature and also recommend effective strategies for mitigating climate change impact.
1.3 Research Questions

The study seeks to address the following questions:

- What are the perceptions of female and male farmers on climate change?
- What are the effects of climate change on the livelihoods of female and male farmers?
- What are the adaptation strategies adopted by female and male farmers?
- How do these adaptation strategies affect the livelihoods of female and male farmers?
- How have these adaptation strategies impacted on the physical environment?

1.4 Study Objectives

The main objective of the study is to examine female and male perceptions of climate change, impacts on livelihoods of farmers and adaption strategies.

The specific objectives are to:

- Assess the perception of female and male farmers on climate change.
- Examine the effects of climate change on the livelihood of female and male farmers.
- Investigate the adaptation strategies adopted by female and male farmers.
- Assess the effects of the adaptation strategies on the livelihoods of female and male farmers.
- Determine the effects of the adopted adaptation strategies on the physical environment.
1.5 Hypothesis

H_0 – There is no significant difference between female and male farmers’ perceptions on climate change.

H_A - There is a significant difference between female and male farmers’ perceptions on climate change.

H_0 – There is no significant relationship in the climate change adaptation strategies adopted by female and male farmers.

H_A - There is a significant relationship in the climate change adaptation strategies adopted by female and male farmers.

1.6 Justification of Study

The study intends conveying to the fore, issues on climate change perception and adaptation strategies in the Tolon District in Northern Ghana. This study focuses on the perception of the small holder farmers, their adaptation strategies and how these affect the physical environment.

The study contributes to existing literature and knowledge through the provision of information on the gender dimensions in adopting adaptation strategies and its effects on female and male farmers.

Also, the study contributes to knowledge through the adoption of a mixed method research strategy over the many qualitative approaches used in climate change and gender literatures.

Finally, this research provides information for policy consideration in the implementation of gender sensitive solutions to climate change and adaptive strategies adopted by female and male farmers. This will help governments and policy makers in making gender sensitive decisions for targeted interventions.
1.7 Organization of Study

Chapter One of the study provides a general background to climate change in the context of adaptation and gender, outlines the problem statement, research objectives, research questions, hypothesis and structure of the study is organized. Chapter Two is the literature review discussed under themes relevant to the topic. Chapter Three discusses the methodological approach adopted for the study; and also provides a background description of the study area, whiles Chapter Four dwells on the analysis and discussion of the demographics and perceptions of climate change. Chapter Five presents the adaptation strategies adopted by female and male farmers, the effect of adaptation strategies on livelihoods and the effects of the adopted adaptation strategies on the physical environment. Finally, Chapter Six summarizes the key findings, conclusion and recommendations of the study.
CHAPTER TWO
LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK

2.0 Introduction

This chapter focuses on a review of related literature to the study. The review however dwells on the concept of climate change, effects of climate change, gendered vulnerability to climate change and climate change adaptation. The chapter also examines literature on adaptation strategies at small holder farmer levels and mainstreaming gender into climate change adaptation strategies. The chapter finally discusses the conceptual framework of the study.

2.1 Understanding the Concept of Climate Change

Climate change refers to a statistically significant variation in either the mean state of the climate or in its variability, persisting for an extended period (typically decades or longer). Climate change may be due to natural processes or external forces, or to persistent anthropogenic changes in the composition of the atmosphere or in land-use (IPCC TAR, 2001). Climate change is one of humanity’s greatest challenges, affecting both current and future generations (Lagos and Wirth, 2009). Changes in temperature and other climatic features will vary globally with the likelihood of weather extremes remaining high (Simpson et al., 2008).

Climate change produces varying scenarios across the globe, for e.g., within the West African sub-region there is an anticipated increase in mean surface temperature of up to 0.5°C per decade and increased evapo-transpiration (OECD, 2009). The interactions of these scenarios with other features of climate variability results in great levels of uncertainty at the regional scale with regards to changes in frequency and storm tracks (Christensen et al., 2007). In South Sudan, the Sudan Post-Conflict Environmental Assessment (UNEP, 2007 cited in UNDPSS, 2012) identifies climate change as one of the most important threats to the
development of the country. According to this assessment, expected changes in weather patterns are projected to exacerbate existing household vulnerabilities and to exceed current coping mechanisms that will limit poor people’s capacity to maintain sustainable livelihoods. The changing climate has been implicated as a key factor of human insecurity (WEDO, 2008). It is a central deriver of insecure living conditions, food insecurity and forced migrations. Climate change particularly threatens the livelihoods of smallholder farmers through the impacts of extremes of rainfall and heat (Müller-Kuckelberg, 2012). Among smallholder farmers across sub-Saharan Africa, climate change remains the biggest threat to food security (Annez et al., 2010).

In Ghana for example, small holder farmers are largely dependent on the starchy and cereal staples for subsistence with maize being the most important and dominant staple produced in all the six agro-ecological zones of Ghana. However, recent studies indicate that climate change impacts are playing key roles in the decrease in maize production due to its high sensitivity to rainfall and temperature variability (Klutse et al., 2013). This has serious implications for food security, consequently about 18% of Ghanaians who are mostly dependent on agriculture and fall below the extreme poverty line are reported to be chronically food insecure (MESTI, 2012). A regional analysis of climate change vulnerability in the poorest regions reveals that 34% of households in the Upper West region were experiencing food insecurity compared to 2% in Greater Accra (MESTI, 2012).

2.2 Effects of Climate Change

Climate change poses great challenges to society, particularly in developing countries (UNDP, 2011). The impacts of climate change could reverse decades of human development gains and threaten the achievement of the sustainable Development Goals (SDGs). While developing countries remain the most vulnerable to these future threats, they have limited
capacity to adapt to impending climate impacts (UNDP, 2011). Lagos and Wirth (2009) noted that without concerted action, climate change will damage fragile ecosystems, impede development efforts, increase risks to public health, frustrate poverty alleviation programs, and force large-scale migration from water or food-scarce regions.

The environmental, economic, and social costs of inaction will far exceed the cost of taking immediate steps to address climate change. Analyzing the impacts of climate change on tourism, Simpson et al., (2008) noted that with its close connections to the environment and climate itself, tourism is considered to be a highly climate-sensitive economic sector similar to agriculture, insurance, energy and transportation. Unabated, climate change would increase the risks and costs substantially and so both mitigation and adaptation strategies are required immediately to limit the impact of climate change on the ability to achieve the UN Sustainable Development Goals (Simpson et al., 2008). UNDPSS (2012) noted that climate change conditions in Africa describes impact of this on sub-Saharan Africa south Sudan which has expected impacts in varying areas such as increased water scarcity, accelerated desertification and soil erosion processes, decreased productivity (with 20% drop in crop yields predicted), damages caused from extreme climate events (e.g. droughts and floods), increased health-related illnesses, and higher risk of pest and disease outbreaks. Similarly, Akpalu and Rosen (2015) noted that climate change has affected various sectors including the dominant agricultural sector. With noticeable decline in rainfall across the country and increasing temperatures, the effect is noted to vary across the different ecological zones. Temperatures and rainfall continue to increase and decrease respectively as one move from the south towards the northern region. The resulting effect is mainly felt on the agricultural sector upon which the economy and majority of citizens gets a livelihood (Akpalu and Rosen, 2015).
The Food and Agriculture Organization (2012a) (FAO) noted that climate change brings critically new perspectives to important global challenges relevant to food security and rural livelihoods. Climate change is expected to impact significantly on food systems of households, especially for smallholder farmers in developing countries who have limited or lack adaptive and coping capacities (Jones and Thornton, 2003; IPCC, 2007).

In Ghana, prolonged drought is one of the most serious climate hazards. In the northern parts of the country, intense dry periods and shorter wet seasons are beginning to affect huge river systems such as the Volta, resulting in serious water shortages and adverse consequences for the agriculture and forestry sectors. An observed 1°C increase in temperature from 1960-2000 has brought great pressure on the largely climate sensitive economic sectors, including the agriculture sector which is the main source of livelihood to the majority of the population.

Smallholder farmers (about 90%) who cultivate usually less than two (2) acres of land often face losses in production due to these erratic weather conditions. More frequent and longer dry periods also threaten crop failures including the staple maize which is known to be particularly susceptible to drought (Klutse et al., 2013; Jones and Thornton 2003).

An assessment of Ghana’s vulnerability to climate change has identified five main drivers; temperature, precipitation, sea level rise, atmospheric carbon dioxide content and incidence of extreme events. These would lead to a number of effects in the agricultural sector: among these are reduced crop yields and agriculture production increased occurrence of pest attacks, food security and malnutrition, intense droughts, limited water availability, declined soil fertility, food security and malnutrition and low livestock productivity and high production cost (Agyemang-Bonsu et al., 2008). These climate change impacts on the sensitive economic sectors, especially agriculture, increases the vulnerabilities of a large proportion of the population who tend to adapt by resorting to movements including rural-urban migration and environmental refugees. The vulnerability of Ghana to climate change stems from the
lack of adaptive capacity while its susceptibility is further exacerbated by the lack of adapting strategies due to the lack of institutional, economic and financial capacity (Agyeman-Bonsu et al., 2008; Baffoe-Bonnie et al., 2008).

In the discourse of the effects of climate change on agriculture, it is worth to note that agriculture is not just a casualty of climate change but also a significant contributor by itself. Emissions of greenhouse gases from agricultural sources are estimated to be responsible for between 10-12% of emissions and indirectly accounts for deforestation (Pye-Smith, 2011).

2.3 Gendered Vulnerability to Climate Change

Due to differences in the biological make up, behavioral patterns and socially constructed roles and responsibilities of men and women, the impact of climate change will be felt differently (Nampinga, 2008). Gender sensitive response to climate change mainly refers to rural context, for instance adaptation in agriculture (Alber, 2011). Women are particularly vulnerable to climate change because they are more prone to the adverse impacts from climate change. This arises from limited adaptive capacities due to social inequalities and ascribed socio-economic roles that lead to differences in property rights, access to information, lack of employment and unequal access to resources (Bridge, 1994; WEDO, 2007)

Gender inequalities, needs and tastes which vary over space and time impacts the specific ways in which climate change affects males and females of all age groups and the ways in which they develop strategies to adapt (Otzelberger, 2011). In research carried out with women’s groups in India and in Sweden, the importance of gender equality and of the relation of third world women to the environment was self-evident in the areas of development, work, research and others. Development and certain standards of welfare made this issue appear to be less urgent in the rich countries like Sweden. However, research
showed otherwise. Gender and power in environmental management is relevant in the poorer countries like India but also very much so in a country like Sweden. In the latter, power relations can take forms that make gendered discrimination more difficult to contest. Secondly, development discourse about equality and empowerment of oppressed third world women bear not only on how gender equality is concentrated and practiced in the south but also shapes for gender equality in the north (Muhanguzi, 2011).

The dependence of women on natural resources threatened by climate change for their livelihoods increases their exposure to the adverse impacts (WEDO, 2007). Women in rural areas in developing countries have the major responsibility for household water supply and energy for cooking and heating, as well as for food security, and are negatively affected by drought, uncertain rainfall and deforestation. Current changes in climate have led to decreased food security and a resultant unpredictable and scarce traditional food sources. Women therefore face the risk of loss of harvests which often happens to be their sole source of food and income. Moreover, it is clear that changes in the climate usually impact on sectors that are conventionally associated with women and hence their increased vulnerability (WEDO, 2007). In Ghana for example, women constitute an important component of Ghana’s economy as they produce 70% of the nation’s subsistence crops and account for 52% of its labour force (MEST, 2012). Even though women undertake about 85% of Ghana’s food distribution, access to land; land tenure security and formal financial services remain major difficulties faced by women in their livelihood activities (Bridge, 1994; WEDO, 2007).

2.4 Climate Change Adaptation

Adaptation is defined as “adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Various types of adaptation can be distinguished, including anticipatory and
reactive adaptation, private and public adaptation, and autonomous and planned adaptation” (IPCC TAR, 2001). UNDP (2005) also defines adaptation as a process by which strategies to moderate, cope with and take advantage of the consequences of climatic events are enhanced, developed, and implemented. Given the far-ranging adverse effects of climate change, adaptation must be an integrated component of an effective strategy to address climate change, along with mitigation (Lagos and Wirth, 2009). In Agriculture, Deressa et al., (2009) define adaptation as crop switching, late planting, soil conservation and tree planting. They showed that the level of education, gender, age, and wealth of head of household, access to extension and credit, information on climate and temperature all influence the choice of a farmer. Swart et al., (2009) notes that Adaptation comprises all spontaneous responses and planned actions taken to cope with the impacts of or reduce vulnerability to a challenging climate. Adger et al., (2007) was of the view that in the past, adaptation measures have seldom been undertaken in response to climate change alone, but have been part of approaches that deal with extreme weather events. However, as the risk and urgency associated with climate change increases, so to does the need to address adaptation explicitly (Swart et al., 2009).

Compared to climate change mitigation, climate change adaptation policy development is still in its infancy (IFRC, 2009). Involvement of local authorities and community based organizations in the development of adaptation strategies is crucial (IFRC, 2009). Risk reduction and risk management are key elements of any adaptation measure. More extensive adaptation than is currently being applied will be necessary to reduce vulnerability to future climate change (IFRC, 2009). Sustainable development can reduce vulnerability to climate change by enhancing adaptive capacity and increasing resilience (IFRC, 2009). Disaster risk reduction and climate change adaptation cannot be dealt with in isolation (IFRC, 2009). IFRC (2009) identified the following climate change adaptation strategies for local impact:

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prioritize adaptation efforts in communities where vulnerabilities are highest and the need for safety and resilience is greatest; build projected climate change related trends in today’s risk and vulnerability assessments based on current climate variability, fully integrate adaptation into longer term national and local sustainable development and poverty reduction strategies, prioritize the strengthening of existing capacities- among local authorities, civil society organizations, and the private sector - to lay the foundations for the robust management of climate risk and the rapid scaling up of adaptation through community-based risk reduction and effective local governance, develop robust resource mobilization mechanisms for adaptation that ensure the flow of both financial and technical support to local actors, and leveraging the opportunities in disaster prevention and response, through improved early warning systems, contingency planning and integrated response to promote effective community-based adaptation and risk reduction.

Local actors are the key to achieving real impacts on the ground while international donors and national governments play important roles in establishing effective enabling environments and channeling resources and technical support. Ultimately, effective adaptation takes place through the dynamics of local governance, civil society engagement, and economic development building, from the actions of local authorities, civil society organizations and private sector businesses. There is little evidence of systematic integration of disaster risk management and climate change adaptation other than coordination and awareness-raising. At the local level, where poverty levels are high and there is limited adaptive capacity, there is the need to focus on current climate vulnerability and immediate risk rather than on the long-term impacts of climate change (IFRC, 2009). It is also important to recognize that international policy formulation and donor assistance represent only a small portion of overall development input at local level, even though they can play a critical role
in supporting local stakeholders to initiate and scale up capacity building for adaptation action.

The need for international cooperation will continue to grow as climate change increases and changes the profile of disaster risk in many countries. Lagos and Wirth (2009) noted that adaptation is not simply a matter of designing projects or putting together lists of measures to reduce the impacts of climate change. A national policy response should be anticipatory, not reactive, and should be anchored in a country’s framework for economic growth and sustainable development, and integrated with its poverty reduction strategies (Lagos and Wirth, 2009). National governments bear the responsibility to develop and implement integrated policies and programs that build the resilience and reduce the vulnerability of their populations, emphasizing preventive local actions, to manage the risks associated with the impacts of climate change (Lagos and Wirth, 2009). Information is crucial for planning purposes in climate change adaption.

Relevant questions have been asked as to what adaptation strategies should entail. Lagos and Wirth (2009) suggest that since the impacts of climate change are far-reaching, adaptation strategies must encompass a wide range of policy areas and economic sectors, involving many diverse approaches and actions that contribute to building the resilience of people and countries and address the multiple drivers of vulnerability, including poverty. Effective adaptation will require broader planning and implementation capacity in all relevant government sectors and departments in developing countries - not just in departments of environments. Adaptive strategies are those that can be evaluated by the following principles: scale (match responses to the growing numbers of people in danger), speed (waste no time because climate change is happening faster than predicted), focus (manage risk, build resilience of the world’s poorest citizens, and enhance the ecosystem functions upon which those citizens depend), and integration (recognize the relationships between environment,
development, and climate change, and manage synergies and trade-offs between mitigation and adaptation). It is reckoned that effective adaptation requires participatory democracy, functioning institutions, and transparency at all levels. People at risk must have access to information, and be able to voice out their views and concerns.

CDWR (2008) noted that the broad categories of adaptation strategies for climate change fall under four major categories: investment, regional, statewide and improving management and decision-making capacity. It is explained that adaptive responses to climate change will not come without a cost. Climate change presents an ongoing risk that requires a long-term funding that is properly matched to anticipated expenditures, beneficiaries and responsible parties (CDWR, 2008). Furthermore, it is highlighted that economic and environmental impacts depend upon location, so adaptation strategies must be regionally appropriate (CDWR, 2008). Simpson et al., (2008) highlight the need for adaptation to reduce the cost of climate change impacts and thus reduce the need for mitigation. Adaptation and mitigation are substitutable up to a point, but mitigation will always be required to avoid irreversible changes to the climate system. On the other hand, adaptation will still be necessary due to the irreversible climate change resulting from current and historic rises in greenhouse gases and the inertia in the climate system. The FAO (2012a) argued that mainstreaming climate change issues into development as a necessary step of overall development policy alone is insufficient. It therefore recommends the formulation of sustainable development policies in order to include important new temporal and spatial scales that have become relevant only because of climate change. The FAO (2012b) further indicates that adaptation is necessary to limit potential risks of the unavoidable residual climatic change now and in coming decades. Considering the interventions made in adapting to climate change, UNDPSS (2012) noted that populations are presently vulnerable to climate change-related impacts and disasters due
to the dependence of their households and most of their economic activities on water. It is thus imperative that policies of climate change adaptation should among other things address planning of settlements and facilities. Strategies that help to reduce the potential negative impacts of climate change on food production systems with a focus on rural livelihoods in poor developing countries serve to maintain global and regional food security and must be a priority of climate policy responses (FAO, 2012a). A commitment to feeding the hungry and lifting increasing numbers of rural farmers in developing countries out of poverty for current and future generations must be a strong focus of adaptation and mitigation planning. The Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) stressed the high level of vulnerability of most developing countries to the impacts of climate change and highlighted the need for an integrated approach across different sectors and levels to develop sound and long-term programmes of action both for adaptation and mitigation. As a response, the United Nations Framework Convention on Climate Change (UNFCCC) has requested country Parties to develop several policies, strategies and action plans in the context of their process to mainstream climate change into their development agenda.

Ghana has also therefore completed or is currently developing a number of these documents which include among others the National Adaptation Plans of Action (NAPAs), National Communications (NCs), National Adaptation Plans (NAPs); Biennial Update Reports (BURs) and intended National Determined Contributions (iNDCs). A number of support programmes (e.g. the FAO corporate Adaptation Framework and the co-developed UN-REDD+ strategy) have been developed and are being implemented in collaboration with players such as NGOs, civil society, research organizations and the private sector which have been engaged to support the country’s efforts to tackle climate change. Some adaptation strategies being promoted in the agricultural sector and backed by national climate change
policies include Climate Smart Agriculture (CSA), Conservation Agriculture (CA) among others.

2.4.1 Adaptation Strategies at the Small Holder Level

In order for the smallholder farmers to achieve food security and improve livelihoods in a changing climate, sustainable transformation directed towards increases in agricultural productivity and building food systems resilience to climate change are required (UN Climate Summit, 2014). In the quest to provide the appropriate approach to achieving these objectives, concepts such as Climate-Smart Agriculture (CSA) has been proposed in 2010 as a viable and an integrative approach to addressing the challenges of food security and climate change. CSA aims at achieving three main objectives, including sustainably increasing agricultural productivity, adapting and building resilience of agricultural and food security systems to climate change at multiple levels and reducing greenhouse gas emissions (World Bank, 2010, McCarthy, 2011). CSA involves practices like intercropping, water conservation, conservation agriculture, agro-forestry, together with innovative practices such as better forecasting, knowledge sharing, drought and flood tolerant crops and crop insurance (CCAFS, 2014).

CSA takes advantage of synergies and minimizes tradeoff across actions (Harvey et al., 2014). For instance, practices like the use of water conservation such as minimum tillage can increase organic carbon in soils, improve soil moisture and reduce erosion during extreme weather events (Hobbs, 2007; Harvey et al., 2014). CSA and the use of ecosystem-based adaptation (EbA) strategies at the individual levels have been known to achieve great successes in many African countries. For example in semi-arid zones, there has been success with practices like contour bunds/zai pits that increase millet/sorghum yields by 100%, use of
drought tolerant maize varieties in Cameroun that improve the food security of farmers in drought seasons, and in Malawi, intercropping maize with pigeon peas (a nitrogen fixing legume) provided farmers with 100-250kg of nitrogen per hectare and enhanced maize yields (Harvey et al. 2014; Bogdanski, 2012). In the Northern parts of Ghana, both conservation agriculture (CA) and EbA strategies such as the use of manure, farm residue management, stone/grass bundling and tree planting are being adopted by small holder farmers to conserve moisture, soil and soil fertility. Planting of early maturing, drought and pest resistant varieties, intercropping, crop rotation and the use of irrigation are being adopted as an insurance against rainfall variability and fluctuations and resultant crop failures.

2.4.2 Mainstreaming Gender into Climate Change Adaptation Strategies

The term gender was adopted first by John Money in 1955 to represent sexual attributes of people (Money, 1973). Since then, the term has widely been defined to refer to the socially constructed differences between men and women. This study adopts the widely accepted definition of gender. Gender is dynamic, meaning the cultured gender roles and expectations are not naturally predetermined. The roles and expectations vary within and between cultures and can be revised by systems of social differentiation such as political status, class and age (UNESCO, 2003).

Gender mainstreaming as a tool to assess the different implications for women and men of planned legislation, policies and programmes are required in all areas and at all levels including climate policy. This is crucial as climate change and climate policy might otherwise exacerbate existing inequalities. Without taking gender issues into account, many climate change policies and measures are very likely to be less effective since they might reach and involve only a part of the citizens, or their outcome might be harmful for certain social groups. As mentioned by Alber, (2011), there are two main reasons why gender issues must
be addressed in climate policy: (i) both men and women need to be equally or meaningfully involved in planning and decision making. (ii) it is a measure of the effectiveness and efficiency of climate change policy.

There is limited exploration both in policy and practice of how gender dynamics affect or shape adaptation strategies both at the local and national scales. There is an obvious neglect of gender in the analysis of urban and peri-urban climate change processes, although UN-Habitat (2010) has begun exploring some of the critical aspects with the broader aim of ensuring gender equality in urban development. Common opinions in the majority of climate change and gender literature are centered on children, older people and climate change and indigenous groups as well. The issues include among others:

- The existence of insufficient study, information and evidence on the gender-differentiated nature of climate change impacts particularly at the local level;
- The obvious overlook of the impacts of climate change on women as a result of the lack of gender equality and the invisible nature of gender issues;
- There is a strong need for an improved understanding of how climate change impacts differentiated social groups and of how their capabilities can be built (WEDO, 2007).

In recent times, policies, programmes and projects that are planned and implemented are beginning to present opportunities to learn lessons about the need to improve gender equality and promoting women’s empowerment, as well as mainstream gender considerations in adaptation policies and programs at the national levels. Governments are being encouraged to mainstream gender perspectives into their national policies, action plans and other measures on sustainable development and climate change, through carrying out systematic gender analysis, collecting and utilizing sex-disaggregated data, establishing gender-sensitive indicators and benchmarks and developing practical tools to support increased attention to
gender perspectives. Consultation with and participation of women in climate change initiatives must be ensured and the role of women’s groups and networks strengthened (IRADe, 2007).

Women have a strong body of knowledge and expertise that can be used in climate change mitigation, disaster reduction and adaptation strategies. Women’s responsibilities in households and communities as stewards of natural resources has positioned them well for livelihood strategies adapted to changing environmental realities. Women tend, however, to be underrepresented in decision-making on sustainable development, including on climate change, and this impedes their ability to contribute their unique and valuable perspectives and expertise on climate change. Technological developments related to climate change should take into account women’s specific priorities and needs and make full use of their knowledge and expertise, including traditional practices. Women’s involvement in the development of new technologies can ensure that they are user-friendly, effective and sustainable. Women should also have equal access to training, credit and skills-development programmes to ensure their full participation in climate change initiatives (UNFPA and WEDO, 2009).

In Ghana, the government has recognised the need to mainstream gender into climate change adaptation efforts, systematically and effectively target gender-specific impacts of climate change in the areas of energy, water, food security, agriculture and fisheries, biodiversity and ecosystem services, health, industry, human settlements, disaster management, and conflict and security. The governments also is aware of the fact that in order to address gender concerns in climate change, there is the need to first address gender inequities and recognize that the effects of climate change are likely to affect men and women differently (MEST, 2012). Major climate change policy documents have broadly recognized the need to mainstream gender considerations in the adaptation efforts across sectors but have fallen
short of outlining specific actions for implementation particularly at the local levels. The National Climate Change Policy (NCCP, 2013) accepts that the human impact of climate change falls, for the most part on the poor and very often on women and children, the aged and the physically challenged. As such, social protection and social safety nets to smooth out inequities and building a more cohesive society are vital for climate resilience and national development. Within the Agricultural sector, the second Food and Agriculture Sector Development Policy (FASDEP II, 2007) document also recognizes the challenges in gender issues in relation to women access to resources including land, credit facilities and extension services. Due to inadequate gender mainstreaming, extension planning, delivery and content may not address their needs and conditions. The Wildlife Division Policy on Collaborative Community Based Wildlife Management also in its policy supports the active participation of women at all levels of decision making in wildlife management and identified the role of mainstreaming gender although not in specific reference to climate change (GFWP, 2012).

Within the context of gender mainstreaming, the participation of women across all sectors of the society is inadequate even though the major policies on adaptation outline broadly the involvement of women in training, public awareness campaigns, formal and non-formal education and decision-making processes in environmental management.

2.5 Ecosystem Based Adaptation Strategies to Climate Change

Ecosystem-based adaptation has been prominent in environment and disaster literature for decades now, and its growing importance has been much echoed in recent times with increasing environmental challenges. CBC (2009) noted that Ecosystem-based adaptation is the use of ecosystem services as part of an overall adaptation approach to help people adapt to the negative effects of climate change. The Intergovernmental Panel on Climate Change (IPCC) (2014) have increased attention to the concept in recent times after the Convention on
Biological Diversity (CBD) has played an innovative role in raising awareness on the concept. The concept of ecosystem services as “the conditions and processes through which natural ecosystems, and the species that make them up, sustain and fulfil human life” (Daily, 1997, p. 3) has expanded rapidly in recent years (Hubacek & Kronenberg, 2013). Adaptation actions are often roughly divided into so called 'hard' and 'soft' approaches, with the former focusing on engineered structures, and the latter on information and institutional capacity building (Jones et al., 2012). Ecosystem-based measures can be considered either as a 'third way' (Jones et al., 2012) or as part of a more widely framed 'soft' approach (Sovacool, 2011).

In ecosystem-based adaptation strategies, ecological structures, their functions and services provided are used to increase the capacity of areas and the capacity of residents to cope with the extreme events which will become more common in the future (Naumann et al., 2011), as well as providing the potential for multiple social, economic, and environmental objectives or 'co-benefits' to be achieved. The frequently mentioned adaptation services of ecological structures such as wetlands, vegetation, forests, grasslands, water bodies and components such as parks, gardens, street trees and ponds include regulating services such as water, soil, local climate and natural hazard regulation (Niven, 2014; Niemela et al, 2010). According to Munroe et al (2012), Ecosystem-based adaptation is being enthusiastically promoted by conservation and development organizations that recognize the integral relationship between ecosystem and livelihoods and the threat that climate change poses to these. Despite its prominence in literature, Munroe et al (2012) argues that the many case studies on ecosystem-based adaptation lacked scientific assessment that provides reliable and robust evidence indicating how effective the approaches were. The UNFCCC Secretariat (2010) notes that apart from financial and economic assessments, social appraisal is important in any assessment of cost and benefits of adaptation options, more importantly because the impacts of climate change often disproportionately affect the most vulnerable communities and
groups. Lo (2016) notes that ecosystem-based adaptation share the rationale of working with nature, and most converge on the principle of sustainable management, conservation and restoration of ecosystem, as part of an overall adaptation strategy. Furthermore, it builds upon and uses approaches that already exist in the practice of biodiversity and ecosystem conservation, climate change adaptation and livelihood development, community based natural resource management (CBNRM), Community-based Adaptation (CBA), and Climate Change Integrated Conservation Strategies (CLICS).

2.6 Perception of Climate Change

Perception of climate change varies from individual experiences to interpretations from experts based on empirical statistical data (Weber, 2010). People’s perception of climate change risk is closely related to their adaptive behavior and mitigation action (Kabir et al, 2016). Perception of climate change does not only vary on individual level but on broader scales. UNESCO (2014) noted that perceptions of climate change and its impacts also vary between countries. This means that geographic factors are essential factors that influence perception of the phenomenon of climate change. Climate change perception also varies from the angle of its impacts on society. While some view it as having negative impact on society (Arbuckle et al, 2015), others pay more attention to the positive outcomes that is derived from climate change phenomena. Thus depending on how an individual perceives climate change, behavioral change to natural hazards emanating from climate change could be adaptive or maladaptive. Arbuckle et al, (2015) noted that perceptions regarding climate change is unsettled, and whereas scientific understanding of climate change is firmly established, Weber (2010) explains that public understanding of the phenomenon of climate change varies widely. Marx & Weber (2012) and Slovic (2009) allude to the viewpoint that
whereas the science of climate change is based on analytical processing of large amounts of carefully collected data, individuals tend to base their judgment and decisions on associative and effective models of cognition that are evolutionarily older and rooted more in feeling than in scientific facts. Debela et al (2015) noted that age, educational level, livestock holding, access to climate information and extension services significantly affect people’s perception levels. Deressa et al (2011) also expounded on the locational variations on perception of climate change noting that climate change perception among rural communities is driven by multiple forces, with different households and farm factors influencing whether and to what extent farmers perceive change and its impact on local agriculture. Simply put, perception of cause, and perception of impact of climate change all come to play in influencing adaptive behaviors of farmers to climate change phenomena.

2.7 Conceptual Framework of the Study

The conceptual framework adopted for this study is shown in Figure 2.5. The framework is based on climate change adaptation and gender roles Sustainable Livelihood Framework (Krantz, 2001) and the Climate Change Adaptation Framework (DECLG, 2012) developed by the UK Department for International Development (DFID).

The Sustainable Livelihood Framework approach is principally concerned with people. Hence precise and genuine understanding of people’s strengths “assets” or “capital” is crucial to analyze how people strive to convert their assets into positive livelihood outcomes (Bebbington, 1999). Individuals require a range of assets to attain their self-defined goals; nonetheless, no single capital endowment is sufficient to yield the desired livelihood outcomes on its own. This is particularly true for poor people whose access to any given
category of assets tends to be very limited and as a result have to seek ways of nurturing and combining what assets they do have in innovative ways to ensure survival (DFID, 1999). The DFID Livelihood Approach presents five core asset categories or types of capital on which livelihoods are built (DFID, 2000). These include (i) human capital, (ii) social capital, (iii) natural capital, (iv) physical capital and (v) financial capital. Even though the term ‘capital’ is used, not all the assets are capital stocks in the fixed economic sense of the term (in which capital is the product of investment which yields a flow of benefits over time). Hence the term ‘capital’ is used for the reason that is the common description in the literature.

According to Kollmair and Gamper (2002), assets are of distinct interest for empirical research in order to establish, if those who were able to escape from poverty or livelihood challenges started off with a particular mixture of assets and if such a mixture would be transferable to other livelihood settings. Also these assets types are important in this study since they form the foundation for building rural livelihoods hence any impact (such as shocks from climate change) on them is likely to negatively influence the attainment of rural livelihoods.

(i) Human Capital

In the context of the DFID Livelihood Framework, it is defined as “the skills, knowledge, ability to labor and good health that together enable people to pursue different livelihood strategies and achieve their livelihood objectives” (DFID, 2000). At the household level, human capital is a factor of the total value of labor available; this varies according to household size, skill levels, leadership potential, health status, etc. Human capital appears in the generic framework as a livelihood asset, that is, as a building block or means of achieving livelihood outcomes. Its accretion can also be an end in itself. Many people regard ill health or lack of education as core dimensions of poverty and thus, overcoming these conditions
may be one of their primary livelihood objectives (DFID, 2000). As well as being of intrinsic value, human capital (the ability to command labor) is required in order to make use of any of the four other types of assets. It is therefore essential, though not on its own sufficient, but for the attainment of positive livelihood outcomes (Kollmair and Gamper, 2002).

(ii) Social Capital

There is much argument about what precisely is meant by the term ‘social capital’ means the social resources upon which people draw in quest of their livelihood objectives developed through “network and connectedness”, that increase people’s trust and the ability to cooperate or “membership in more formalized groups” and their systems of rules, norms and sanctions (DFID, 2000). Quite often, access and amount of social capital is determined through birth, age, gender or caste and may even differ within a household. Apparently and often parallel to positive impacts, social capital may also cause effects that are restrictive for development (Kollmair and Gamper, 2002). For instance the membership in groups always entails excluding other stakeholders.

Again, it is vital through its direct impact on other capitals by improving the efficiency of economic relations to public goods through the mutual trusts and obligations it poses onto the community (DFID, 2000). And for the most deprived, social capital often represents a place of refuge in mitigating the effects of shocks or lacks in other capital through informal network.

(iii) Natural Capital

Natural capital is the term used for the natural resource stocks from which resource flows and services (e.g. nutrient cycling, erosion protection) useful for livelihoods are derived. There is an extensive variation in the resources that make up natural capital, from intangible public goods, such as the atmosphere and biodiversity, to divisible assets used directly for production e.g. trees, land etc. (DFID, 2000). Within the framework, the relationship between
natural capital and the vulnerability context is particularly close. Many of the shocks that destroy the livelihoods of the poor are themselves natural processes that destroy natural capital (e.g. fires that destroy forests, floods, droughts and earthquakes that destroy agricultural land) and seasonality is largely due to changes in the productivity of natural capital over the year (DFID, 2000).

Evidently, natural capital is very central to those who derive all or part of their livelihoods from resource-based activities such as farming, fishing, gathering in forests, mineral extraction etc. (Nicol, 2000). However, its significance goes way beyond this. No one would live without the help of key environmental services and food produced from natural capital. Health (human capital) will tend to suffer in areas where air quality is poor as a result of industrial activities or natural disasters (e.g. forest fires) (Ellis, 2000). Besides the understanding of linkages between resources remains limited, although humans depend for health and wellbeing upon the continued functioning of complex ecosystems.

(iv) Physical Capital

According to DFID (2000), physical capital involves the basic infrastructure and producer goods needed to support livelihoods, such as cheap transport; safe shelter and buildings; adequate water supply and sanitation; clean, cheap energy; and access to information. Its impact on the sustainability of a livelihood system is best fit for demonstration through the notion of opportunity costs as a poor infrastructure can prevent education, access to health services and income generation (Calow, 2001). Also, without transport infrastructure, vital fertilizers cannot be disseminated effectively, agricultural yields remain low and it is then difficult and expensive to transport limited produce to the market. The increased cost (in terms of all types of capital) of production and transport means that producers operate at a comparative disadvantage in the market (Ashley, 2000).

According to Nicol (2000), infrastructure is commonly a public good that is used without
direct payment. Exceptions include shelter, which is often privately owned, and some other infrastructure that is accessed for a fee related to usage (e.g. toll roads and energy supplies). Producer goods may be owned on an individual or group basis or accessed through rental or ‘fee for service’ markets, the latter being common with more sophisticated equipment.

(v) Financial Capital

Financial capital means the financial resources that people use to achieve their livelihood objectives. The definition used here is not carefully robust in that it includes flows as well as stocks and it can contribute to consumption as well as production (DFID, 2000). But, it has been adopted to try to capture an important livelihood building block, namely the availability of cash which permits people to adopt different livelihood strategies (Kollmair and Gamper, 2002).

According to DFID (2000), there are two main sources of financial capital:

- **Available stocks**: Savings are the preferred type of financial capital because they do not have liabilities attached and usually do not entail reliance on others. They can be held in several forms: cash, bank deposits or liquid assets such as livestock and jewelry. Financial resources can also be obtained through credit-providing institutions.

- **Regular inflows of money**: The most common types of inflows are labor income, pensions, or other transfers from the state, and remittances. In order to make a positive contribution to financial capital these inflows must be reliable (while complete reliability can never be guaranteed there is a difference between a one-off payment and a regular transfer on the basis of which people can plan investments).

Among the five categories of assets, financial capital is probably the most multipurpose as it can be converted into other types of capital or can be used for direct realization of livelihood outcomes (e.g. purchasing of food to reduce food insecurity). However, it tends to be the least available asset for the poor (Kollmair and Gamper, 2002).
2.5.1 Livelihood Strategies

Livelihood strategies comprise the range and combination of activities and choices that people undertake in order to achieve their livelihood goals (DFID, 2000). According to Kollmair and Gamper (2002), livelihood strategies need to be understood as a dynamic process in which people combine activities to meet their various needs at different times and on different geographical or economical levels, where they may even differ within a household. Their dependence on assets status and transforming structures and processes becomes clear through the position they occupy within the framework. A changing asset status may further hinder other strategies depending on the policies and institutions at work.

2.5.2 Livelihood Outcomes

The livelihood outcomes according to DFID (2000) and Kollmair and Gamper (2002) are the attainments of livelihoods strategies, such as more income (e.g. cash); increased wellbeing (e.g. non material goods, like self-esteem, health status, access to services, sense of inclusion); reduced vulnerability (e.g. better resilience through increase in assets status); enhanced food security (e.g. increase in financial capital to purchase food); and a more sustainable use of natural resources (e.g. appropriate property rights).

Livelihood outcomes are important because it helps understand the output of the current configuration of factors within the livelihood framework; it demonstrates what motivates stakeholders to act the way they do and what their priorities are (DFID, 2000). Also, livelihood outcomes provide an idea of how people are likely to respond to new chances and which enactment indicators should be used to assess support activity (Kollmair and Gamper, 2002). In addition, livelihood outcomes openly influence the assets and change vigorously the form of the asset pentagon offering a new starting point for other strategies and outcomes (DFID, 2000; Kollmair and Gamper, 2002).
The interconnections between various livelihood strategies/activities results in livelihood outcomes. These outcomes could be positive or negative. According the framework on climate change adaptation, adaptation strategies are measures geared towards addressing climate change impacts. The framework on climate change and gender above provide a network of several interconnecting processes on climate change, adaptation and gender roles. According to the framework, climate change has two broad underlying cause factors namely the natural processes and the societal processes. The change in climate affects livelihood activities of people in a particular community, the livelihood activities undertaken thereof results in livelihood outcomes. However, the nature of the livelihood outcome could be positive or negative depending on the climate change adaptation strategies adopted by a household or community as a whole. Furthermore, the nature of the livelihood outcome leads to maintaining or changing of gender roles which is also interlinked to the livelihood activities undertaken by individuals and society as a whole.
Figure 2.1 Framework of Climate Change Adaptation and Gender

Author’s own construct, 2016
CHAPTER THREE

STUDY AREA AND METHODOLOGY

3.0 Introduction

The study area is in the northern part of Ghana. The locale of the study is the Tolon District of the Northern Region of Ghana. This chapter looks at the demographic characteristics of the study area and also looks at the methodology used for the study.

3.1 Size and Demographics

This study was carried out in six communities in the Tolon district of the Northern Region; Yoggu, Zagua, Fihini, Kpalgum, Dagbusashe and Cheshegu (Figure 2). Tolon/Kumbungu District Assembly is one of the 45 new districts created by the erstwhile Provisional National Defense Council (PNDC) Law 207 in 1988 with Tolon as its capital. Tolon District, formally Tolon/Kumbungu District, was carved out of the then Western Dagomba District. In 2012, the district was divided and separated from Kumbungu. The District covers an area of approximately 2,741 square kilometers and forms about 3.9% of the total land area of the region. The District lies between 9°26′N and 1°04′W, and share borders with West Mamprusi District in the North, West Gonja District in the West and South, and Savelugu/Nanton District and the Tamale Municipal Assembly in the East.

3.2 Climate and Vegetation

The Tolon district lies within the Guinea savannah ecological zone with two major climatic seasons - wet and dry seasons. The wet season starts from May through to September and the dry season from October and ends in April. Average annual rainfall ranges from 750mm – 1100mm. Rainfall in the district is poorly distributed and torrential. Temperatures can fall to as low as 15°C at night and increase as high as 40°C during the day especially in the dry
season. The dry season is categorized by dry winds known as *harmattan* and during this period evapotranspiration is usually high and is often accompanied by low humidity.

In Tolon, the tributaries of the White River Volta drain through many of the communities. The areas experience long dry season which affects water availability. As a result there is reliance on some man-made dams by the villages. The man-made dams also dry up in the long dry season. Soils in the district are classified under lateritic and savannah ocrrosols type. However, it is reported that 47% of soils in northern Ghana are regarded unsuitable for crop production, 25% are marginal and only 28% are suitable. Soils are generally sandy loam, except in lowland areas where alluvial soils are found. According to Songsore (2011), land
degradation resulting from soil erosion and unsustainable land use practice has reduced soil fertility in most farmlands. Dominant trees in the district include Dawadawa (*Parkia biglobosa*), Shea (*Vitellaria paradoxa*), Mango (*Mangifera indica*), Kapok (*Ceiba pentandra*), and Baobab (*Adansonia digitata*).

### 3.3 Socio-Economic Activity

The main livelihood activity employing 90% of the population in the district is agriculture. Farming activities include livestock rearing with staple crop production, including roots and tubers, legumes (peanuts, cowpea and soybean and yam), and cereal (maize, rice and sorghum). Mostly crop productions are intercropped. Women are mostly involved in Shea butter and groundnuts processing as their main livelihood activity. Tolon has one of the highest proportions of rural-urban migrants to Accra, the capital of Ghana (Boakye-Danquah *et al.*, 2014).

### 3.4 Methodology

#### 3.4.1 Research Strategy

The mixed method which permits the use of both qualitative and quantitative methods was employed to successfully conduct this study. These methods generate subjective interpretation to discuss statistical results (Teye 2012; Brymann 2001).

#### 3.4.2 Research Design

Research design is a construction for data collection and analysis is developed. The comparative research design was employed for this study to compare formal and current livelihood activities and climate change. Fieldwork was conducted in six communities in the
Tolon District to collect data on the livelihoods of men and women on parameters such as agriculture (crops available for women and men to grow), food security (food availability, accessibility, utilization and stability), water (scarcity and accessibility), health (ailments as a result of climate change) and income variation. A reconnaissance survey was initially conducted in the six communities to gain firsthand knowledge on gender perspectives on climate change adaptation.

3.4.3 Modes of and Instruments for Data Acquisition

The study used a number of resources and methods for data acquisition. The data collection was however conducted in July to August, 2015. The key methods include literature review using secondary sources, household level survey using questionnaires, in-depth interviews with female and male household heads, and focus group discussions (FDGs) with three social groups – men, women and youth.

Semi-structured interviews with key stakeholders such as leaders of women and men groups or associations were conducted to understand their perspectives on climate change and variability. Independent observations of the livelihood activities of the study communities were also carried out to gain first-hand information on the socio-economic activities in the area. Questionnaires were administered with the help of a facilitator who translated the questions into the local language (Dagbani). A total of nine (9) FGDs were held in three study communities with male, female and youth groups, the interaction was recorded and later transcribed for further analysis. A Garmin hand held GPS was used to record the coordinates of each of the respondent locations.
3.4.4 Sampling Technique, Design and Sample Size

A sample of 250 respondents was selected for in-depth household interviews across the six communities. The sample was proportionally allocated to the study communities on the basis of their population as obtained from the 2010 Population and Housing Census. A simple random sampling technique was used for selecting respondents based on a 60:40 percent ratio between males and females in each of the communities for the in-depth interview based on differences in population size.

3.4.5 Data Analysis

Data analysis is defined as management, analysis and interpretation of collected data for write up of research report (Brymann, 2001). Data management is as important as data analysis and using the result of analysis for proper discussion. Data analysis stage is basically about data reduction where large volumes of data collected are reduced into simplified knowledge for analysis and interpretation in the context of literature and theory. The recorded interviews and discussions are subsequently transcribed for transcription management. In managing the transcribed data, the researcher must watch out for possible disorder that may distort the responses or views of interviewee(s) to questions (Brymann, 2001). Afterwards, manual thematic analysis was conducted with transcripts by examining the data to extract core themes (Brymann, 2001) via manual labeling of parts of transcripts with codes or labels. Lastly, the questionnaires were analyzed using the statistical package for social sciences (SPSS v.20). Descriptive and inferential statistical analytical methods such as crosstabs and factor analysis were used for the analyses. Frequency tables and pie and bar charts, were also used to represent the data.
CHAPTER FOUR
DEMOGRAPHIC CHARACTERISTICS AND PERCEPTION ON CLIMATE CHANGE

4.0 Introduction

This chapter presents the results and discussions on the data collected for the study. The chapter was divided into two sections. The first describes on the socio-demographic characteristics of respondents in the Tolon district. The second examines the perceptions on climate change and the impact of climatic events on the environment in the study area.

4.1 Socio-Demographic Characteristics of Respondents

This section used descriptive statistics to describe the gender, age, marital status, educational level, religion, household size, years stayed in community among others.

4.1.1 Gender and Age Distribution of Respondents

The gender and age distribution of respondents across all study communities were examined. Such a classification is very useful as it helps in achieving a variety of responses from both men and women based on their individual skills, reflection and views. It is also important to unearth how men and women relate differently to the issue of climate change. Furthermore, the study gathered information on the age distribution of the respondents. The rationale is that, different age groups engage in different livelihood activities. With that, their responses to climate change phenomena will vary based on their specific activities.

The results of a cross tabulation between the gender and age of respondents in the study area are shown in Table 4.1. The results show that the majority of respondents in the age bracket 26-40 years were males constituting 26.4% whiles the females accounted for 19.6% of total
respondents. Those within the age brackets of 41-55 years were made up of 15.2% males and 10% females. Respondents above 56 years however were 13.6% and 7.2% male and female populations, respectively. It is clear with the data that male respondents dominated across all age levels providing an overall average of 60% male respondents as compared to 40% females.

Table 4.1 Socio-Demographic Characteristics of Respondents

<table>
<thead>
<tr>
<th>Gender and Age</th>
<th>Male (%)</th>
<th>Female (%)</th>
<th>Marital Status</th>
<th>Male (%)</th>
<th>Female (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under 25</td>
<td>4.8</td>
<td>3.2</td>
<td>Married</td>
<td>55.2</td>
<td>37.6</td>
</tr>
<tr>
<td>26-40</td>
<td>26.4</td>
<td>19.6</td>
<td>Single</td>
<td>4.0</td>
<td>1.2</td>
</tr>
<tr>
<td>41-55</td>
<td>15.2</td>
<td>10.0</td>
<td>Widowed</td>
<td>0.8</td>
<td>1.2</td>
</tr>
<tr>
<td>56 and above</td>
<td>13.6</td>
<td>7.2</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Household Size</th>
<th>Male (%)</th>
<th>Female (%)</th>
<th>Length of Stay in Community</th>
<th>Male (%)</th>
<th>Female (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under 5</td>
<td>33.8</td>
<td>25.6</td>
<td>Below 9yrs</td>
<td>1.6</td>
<td>3.6</td>
</tr>
<tr>
<td>6-10</td>
<td>16.6</td>
<td>9.8</td>
<td>10-19yrs</td>
<td>2.4</td>
<td>3.6</td>
</tr>
<tr>
<td>11-15</td>
<td>3.8</td>
<td>2.2</td>
<td>20-29yrs</td>
<td>1.2</td>
<td>5.2</td>
</tr>
<tr>
<td>16-20</td>
<td>0.2</td>
<td>0.2</td>
<td>30-39yr</td>
<td>0.8</td>
<td>5.2</td>
</tr>
<tr>
<td>20 and above</td>
<td>5.6</td>
<td>2.2</td>
<td>40yrs and above</td>
<td>2.8</td>
<td>3.6</td>
</tr>
<tr>
<td>Level of Education</td>
<td></td>
<td></td>
<td>All my life</td>
<td>51.2</td>
<td>18.8</td>
</tr>
</tbody>
</table>

| No education | 52.8 | 37.2 |
| Primary      | 1.6  | 0.8  |
| JSH          | 3.6  | 0.8  |
| SHS          | 1.6  | 0.8  |
| Tertiary     | 0.4  | 0.4  |

Source: Field Data, 2015
4.1.2 Number of Dependents in the Household of Respondents

Household size and composition usually have implications for socio-economic wellbeing of residents in terms of their income, education, gender and composition (Phuong, 2012). The term ‘household’ is the basic residential unit that normally includes all individuals living in the same dwelling (Sullivan and Stevens, 2003). However, it is debated that household size and composition is a cause factor for the competencies, choices and adaptation strategies available to its members (Rakodi, 2002). Therefore, considering the household size and its composition of the study is central in this survey to unravel the relationships between the farmers, their families and the livelihood assets that they have right to use in order to form new livelihoods or depend on existing ones.

Table 4.1 shows that 33.8% male dominated household heads had less than 5 total dependents compared to 25.6% female headed household. Households with 6-10 dependents were mainly dominated by male heads (16.6%) compared to female headed homes (9.8%). Also significant was households without any dependents. Male headed households with no dependents constituted 5.6% compared to female headed homes with no dependents (2.2%). Generally, the male headed homes had higher number of dependents than female headed households. The findings of the study confirm works of Hassan and NhemaChena (2008).

4.1.3 Marital Status of Respondents

It is important for the purpose of this study to investigate the marital status of respondents in the study area. This was to identify if those involved in smallholder agriculture are predominantly single or are married people. The study revealed that majority of respondents were married small holder farmers with males and females constituting 55.2% and 37.6%, respectively. However, 1.2% and 4.0% female and male respondents, respectively, were single, whiles the remaining 0.8% and 1.2% respectively, were widowed (Table 4.1).
In view of the results, the majority of smallholder agriculture farmers were married which gives an indication that marital status of a person does not matter when it comes to agriculture. Whether one is married, single or widowed, one can still engage in agricultural activities. The larger number of married smallholder agriculture may have the advantage of additional labour in their farms.

4.1.4 Level of Education of Respondents

Education makes one aware of his or her responsibilities and awakens the consciousness towards climate change adaptation strategizing as in case of agriculture related activities. Smallholder farmer’s years of education is a major determinant that shapes how they perceive their environment including a change in climate (UNDP, 2010).

From the study, about 90% of the respondents do not have any form of formal education (Figure 4.1). Illiteracy is very high in communities, ranging from about 71% in Cheshegu to as high as 95% in Fihini. Yoggu is the only community with at least one respondent having reached the tertiary level of education. Most respondents who have had some level of education terminated at the Junior High School level, as found at Cheshegu, Dagbuashe and Fihini.

The study examined the gender variations in the educational level of respondents. The number of male respondents with educational training (7.2%) was more than the total number of females (2.8%) out of the total respondents. That notwithstanding, generally both men (52.8%) and women (37.2%) of the total respondents had no formal education.
4.1.5 Length of stay in the community by Respondents

Farmers’ perception of climate change is affected by the duration of stay in community and level of exposure to changes in climate. In relation to gender and climate change adaptation strategies, it is important to assess the duration of stay of respondents in the community in order to examine how they appreciate the changing climate, adaptation strategies and gender roles. From the investigation, it is observed that a majority of the respondents (70%) have lived in their respective communities all their lives. For males, 85% of them had lived all their lives in the study communities, while 47% of females have spent all their lives in the respective study communities. In both cases, women and men have lived in their respective communities long enough to detect any change in climate and how these changes are affecting their agricultural activities.
4.1.6 Occupation of Respondents

The study sought to identify the occupation of respondents in the Tolon district. Field observations in the district show that farming activities remain the major occupation of respondents.

The major livelihood activity in the Tolon District is farming. A total of 77.2% of respondents allude to engaging in farming activities (see Table 4.2). A relatively lesser percentage of 2.4% indicate engaging in trading activities. Furthermore, 9.2% of respondents indicate indulgence in other occupational activities including official work, artisanal work, carpentry and masonry. The local people indicate that the lack of alternative livelihood activities limit them to principally engaging in agriculture. Agriculture, as the major occupation of local people, can also be explained by the low level of education and skills which does not offer them options in other areas of work.

Table 4.2 Occupation of Respondents

<table>
<thead>
<tr>
<th>COMMUNITY/OCCUPATION</th>
<th>FARMING</th>
<th>PETTY TRADING</th>
<th>OTHER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>YES</td>
<td>NO</td>
<td>YES</td>
</tr>
<tr>
<td>Cheshegu</td>
<td>57.1</td>
<td>35.7</td>
<td>0</td>
</tr>
<tr>
<td>Dagbuasete</td>
<td>88.2</td>
<td>11.8</td>
<td>0</td>
</tr>
<tr>
<td>Fihini</td>
<td>60.0</td>
<td>40.0</td>
<td>5.0</td>
</tr>
<tr>
<td>Kpalgun</td>
<td>78.9</td>
<td>21.1</td>
<td>1.8</td>
</tr>
<tr>
<td>Yoggu</td>
<td>82.9</td>
<td>14.5</td>
<td>1.7</td>
</tr>
<tr>
<td>Zagua</td>
<td>64.0</td>
<td>36.0</td>
<td>8.0</td>
</tr>
<tr>
<td>Average</td>
<td>71.9</td>
<td>26.5</td>
<td>2.8</td>
</tr>
<tr>
<td>Total</td>
<td>77.2</td>
<td>21.2</td>
<td>2.4</td>
</tr>
</tbody>
</table>

Field Survey, 2015
4.2 Knowledge, Understanding and Perceptions on Climate Variability

4.2.0 Introduction

Climate change is a phenomenon that is very difficult to perceive over a short period. However, a good knowledge of climate change and climatic variability is a necessary step towards adoption of proactive adaptation and coping strategies to avert possible negative effects of climate change. This study therefore sought to explore the knowledge and understanding of local farmers on climate variability and the perceptions they hold about it.

4.2.1 General Distribution of Rainfall and Temperature in the Tolon District

Rainfall and Temperature are two key determining elements of climatic variability. In order to assess the perception of people on climate change, it is important to examine from empirical data, the distribution of these climatic elements and to really provide a meaningful basis on which to juxtapose perceptions of changes in climate in the Tolon District. In this regard, data was obtained from the Ghana Meteorological Services Department on the distribution of rainfall and temperature in the Tolon District. A 30 year period of assessment was made based on the availability of data on these two variables and the results are presented in Figure 4.2.

The distribution of rainfall in Tolon district is marked with high variability as evidenced in the undulating yearly rainfall distribution line. The highest amount of rainfall received in the district was in the year 1991. Prior to that year however, the rainfall received was relatively low at some years and high on others. The period from the 1990s to early 2000s was marked by high and low rainfall. The period after 2005 to 2010 showed a similar pattern of rainfall. Rainfall distribution was relatively uniform albeit around 1000 mm.

The period after 2010 however experienced a steady decline in rainfall. In the year 2015, total rainfall received decreased from 40 inches (1016mm) recorded in 2014 to about 25 inches.
(635mm) in the Tolon district. This is the lowest rainfall figure recorded in more than two decades since 1992.

Temperature variation in the district was also assessed. The distribution of temperature in the Tolon district provides another perspective from which to appraise the changing climate or variability in climate. The maximum temperature has been uniformly high across all the years except for 1996 and 2012, where there has been substantial decline. Some observations made on the relationship between rainfall and temperature includes the following: Firstly, whilst rainfall continued to fluctuate across the years, temperature has been relatively stable and high; secondly, in the year 2013, there was a decline in rainfall. However, Temperature began to rise from its low in 2012. Simpson et al. (2008) noted that changes in climatic conditions would vary serverally across the world defined by the local climate related conditions. They further warned of weather extremes occurring at varying local and global scales. With the increasing temperature conditions and decreasing rainfall patterns observed in the Tolon District the causes are likely to vary from the local to global scales and these changes have the potential to exacerbate household vulnerabilities especially in rural areas where livelihoods of smallholder farmers are dependent on climate conditions (Müller-Kuckelberg, 2012).
Figure 4.2 Rainfall Distributions in Tolon District
Source: GMet Data, 2015
Figure 4.3 Temperature Distributions in Tolon District
Source: GMet Data, 2015
4.2.2 Awareness and Perceptions of Farmers on Climate Change Variability

Meteorological data provides information about changing climatic conditions in Tolon District. The study further investigated the level of awareness and perceptions of local people on climate change variability in their localities.

The study found that the level of awareness of climate change among local people is high (Table 4.3). The results show that all male respondents indicate knowledge of changing climate in their respective geographical settings. Furthermore, 94% of the female respondents acknowledge the occurrence of changes in climate in their area.

Many of the respondents understood the concept of climate change through different means. Firstly, a change in the weather (CW) is one common way that the people in Tolon use to understand climate change. Because their main occupation is farming, the people are very observant of the weather conditions. They take key note of any changes that they observe over the years in the weather patterns. A respondent recounted his experiences with the changing weather patterns:

“When we were growing up, it used to rain a lot and there was a lot of food available during harvest. The soil was very fertile and we used to grow varieties of crops some which we planted early and others late. Now the soil is not that fertile again. When you grow the late maturing crops you are more likely to fail if you don’t apply manure or fertilizer”

“The farm inputs such as the organic manure that we would have carried to the farm, comes at a cost. Either a “motor king” or motor is used in the transportation. So because we don’t have enough money, it affects us. The guinea corn which is an early maturing crop no longer responds very well due to the inadequate rainfall”

Some of the respondents stated that they learn their experiences about changes in the weather from their parents rather than from agricultural extension officers. They indicated that the
extension officers rarely visit their respective communities. They noted however that these extension officers provide them with weather related education through radio interviews. Community members in Yoggu for instance take very keen interest in the radio broadcasts, believe in and practice or take note of any information that was shared by the extension officers through the radio engagements. However, the populace in the Zagua and Fihini communities do not pay much attention to the extension officers since some of them are of the view that they are supposed to visit them on their respective farms and not to educate them through the radio.

Adger et al. (2008) stated that, apart from technology availability and capacity to learn, other factors including the perceptions and knowledge considerations on climate change further limit peoples’ adaptation. Gender determines power and access to resources in most societies and climate change equally affects the interaction, perceptions and ways of male and female groups differentially (FAO, 2015). With both male and female farmers recognising climate change occurrence in the Tolon district, its potential impacts on the residents however will vary according to gender. The study finding however deviates from the earlier work of Constable who found out that climate change perceptions was higher among male respondents than female respondents. She attributed the differences in perceptions to higher male education and likelihood of male respondents to be members of farming groups in Jamaica.
Table 4.3 Level of Awareness on Climate Change among Local People

<table>
<thead>
<tr>
<th>Gender</th>
<th>Are you Aware of Climate Change in your area</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Male</td>
<td>100%</td>
<td>0%</td>
</tr>
<tr>
<td>Female</td>
<td>94%</td>
<td>6%</td>
</tr>
</tbody>
</table>

Field Survey, 2016

**HYPOTHESIS 1**

Hypothesis 1 tested for the level of significance between gender and farmers’ perception of climate change. The test revealed that with a chi-square value of 9.221 at 1 degree of freedom and a P-value of 0.002, the null hypothesis is rejected and the alternate accepted (Table 4.4). The P-value of 0.02 is less than the test significance level of 0.05 showing a statistically significant difference between gender and farmers perception of climate change.

**Table 4.4: Chi-Square Test 1**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Value</th>
<th>Degree of freedom</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chi-square</td>
<td>9.221</td>
<td>1</td>
<td>0.02</td>
</tr>
</tbody>
</table>

Source: Field Data, 2015

Majority of the respondents were between the ages of 26-40 and 41-55 and could only indicate their realization of climate change in 2010. Many of them began their farming activity at a very tender age and follow the instructions of their parents by the time they were 35 or 40. By then, they have gained adequate experiences in farming and weather
information. The study affirms that both female and male in the respective communities of the study area engage themselves in studying the changes in weather.

As narrated by one respondent,

“...when we were kids we used to take note of the rainfall pattern in a year and it comes in three stages. First it will rain with water; as the water is about draining the next set comes when it rains with more water; after that, finally it rains where the water doesn’t drain, it’s everywhere that is when we realize that the rainfall is about leaving. So we used to respond with the appropriate crops to plant. But now with the rainfall pattern we are experiencing, it clearly tells us that we have less rainfall. So right from the onset we are able to determine whether it will rain more or less. So because of what we are experiencing now, we no longer cultivate the late maturing varieties of crops as compared to the earlier maturing varieties” (a Zagua man, FGD 2015).

Another discussant supported the statement above, indicating that;

“..... When we were kids and up to now things have really changed. It’s the farming that we know. Even now, the soil is dead now. And this year to the rain has also not been forthcoming. We used to plant maize even around our house but this is not the case now. Those days when you harvest rice and you don’t collect them early enough, it can geminate again. But this is not the case now” (a Fihini woman, FGD 2015)
According to Figure 4.4, the perceptions of both men and women farmers in the Tolon District that temperature changes are increasing at 98.7% and 97% respectively. However, few males (1.3%) and females (2%) perceive temperature to remain the same without any changes over the period they had lived in the district. No respondent in any case indicated that temperature was decreasing in the Tolon District.

**Figure 4.4 Period of Realisation of Change in Temperature and Precipitation**

Source: Field Data, 2015

**Figure 4.5 Gendered Perceptions on Temperature Change**

Source: Field Data, 2015
Similarly, the perceptions of small holder farmers on changes in precipitation do not vary significantly between males and females in the Tolon District. Figure 4.5 shows that with the exception of one female, who could not express any views on the changing pattern of precipitation, all female (99%) and male (100%) small holder farmers held same perception that precipitation has recorded a decreasing trend over their period of stay in the Tolon District. However, no respondent indicated an increase in the rate of precipitation over the period.

![Figure 4.5 Gendered Perceptions on Change in Precipitation](image)

**Figure 4.6 Gendered Perceptions on Change in Precipitation**

Source: Field Survey, 2015

### 4.3 Climate Change Effects on Livelihood

This section examines the perceived effects of climate change on the livelihood of small holder farmers. It specifically looks at perceived effects of climate change on the livelihood of respondents and the gendered variations in these perceived climatic effects.
4.3.1 Gender Variations in Livelihoods of Farmers Occupation after Livelihoods

The study sought to assess the gender variations in the livelihood occupation of respondents in the Tolon District. Figure 4.6 reveals that majority of male respondents (49.2%) out of the total sample size were engaged in the agricultural sector as farmers, whereas the female counterparts who were engaged in farming as a livelihood accounted for 28% of the total respondents. Also, some respondents are engaged in both farming and trading with men making up 9.6% and women constituting 10.4%. Other respondents were either engaged in petty trading or other economic activities for livelihood. In this regard assessing the human capital according to the DFID, human capital in the various study community is high as they make use of their skills, knowledge and labour. The FAO (2010) noted that just a little less than 20 percent of the worlds land owners were women, whiles they constitute about 43 percent of agricultural labour force in developing countries, 70 percent in South Asia and more than 60 percent in sub-Saharan Africa. Women role in agricultural related activities remain important as they are seen as making critical contributions to their homes in the provision of food and other basic needs of the house.

![Figure 4.7 Occupational Distributions among Men and Women](http://ugspace.ug.edu.gh)

Source: Field Data, 2015
The study examined the perception of local people on the effects of climate change on their livelihood activities (Figure 4.7). Both men (58.8%) and women (38.4%) indicated that climate change has had some effect on their livelihood.

The respondents indicated that the changes in the climate have resulted in changes in farming practices, a reduction of their livestock production, as well as had negative implications on their businesses. Because the weather has become unpredictable coupled with unreliable and inadequate irrigation facilities, farming has become costly as farmers have to purchase fertilizer and rely on manure which are expensive to buy and transport to the farms using tricycles (motor king). Consequently, a majority of the farmers face reductions in their crop production.

This change in weather highly affects livestock production because it reduces the availability of feedstock for the animals; and animals become malnourished and sometimes die from hunger. Excessive heat also affects the livestock.
From Figure 4.8, male farmers (25.2% of respondents) noted that a reduction in livestock production was the major effect on their livelihood, followed by the effects on businesses accounting for 17.2% and reduction in crop production at 16.8%. On the other hand, female farmers noted negative effects on business, reduction in livestock production and reduction in crop production accounting for 14.8%, 14.4% and 10.8%, respectively. Moreover, from the survey it indicates that livelihood outcome in the study community has been affected greatly by climate change. These findings do not vary so much from earlier studies by Ndamani and Watanabe (2016) who also found out that rural farmers perceived climate change to affect agriculture in terms of poor crop performance, environmental degradation, socio-economic and other livelihood challenges and psychological threats. The socio-economic challenges however included out-migration, indebtedness, food shortage and low household incomes. These findings further shows confirms varying studies establishing that climate change affects most rural households in several dimensions as they remain the most vulnerable (Brown et al., 2012)

![Figure 4.9 Perceptions of Climate Change Effect on Livelihoods](http://ugspace.ug.edu.gh)
Perception of climate change varies among men and women and amongst households. It is therefore important to investigate if local people perceive climate change as affecting their households in one way or the other.

![Figure 4.10 Perception of Local People on Whether Climate Change is affecting their Households](source: Field Survey, 2015)

From the study, the majority of the respondents indicate that climate change phenomenon affects their households (Figure 4.9). Male farmers (58.8%) and female farmers (38.4%) expressed the view that climate was affecting their household levels in various ways.

The most pressing effect of climate change on local people in their households is the increase in hunger at homes (Figure 4.10), indicated by 69 percent of perceived effects of climate change on households. Linked to these are an increase in level of poverty (23%) and an increase in health problems (7%). Local people find themselves in a vulnerable situation where they are stressed by poverty, hunger and health problems that their efficiency in
indulging in economic livelihood activities decrease. This findings is similar to Ndamani and Watanabe (2016) who also noted food shortage due to low yields and low incomes available to households as affecting farmers. Their study further noted that such conditions have led to farmers inability to pay back farm resources borrowed from others which sometimes make them traumatized. They indicated that the changes have brought about increased hunger due to low productivity and resultant in food insecurity. As a result, both young and old people fall sick and are unable to afford the hospitals bills. They rely on local medicines which are also gradually becoming scarce (due to changes in climatic conditions) as well as anthropogenic activities. Formerly these medicines were harvested or when farmers were already on the farm, but because its abundance has decreased, farmers spend time searching for the herbs.

A respondent noted that;

“…Because of the insufficient food as a result of food shortage, it brings more problems to us. Hence we are inadequately fed and that affects our health. In some areas too, because the grasses don’t grow, our animal feed is not available and we don’t also get grass to roof our structures” (a Yoggu man, 2015).
4.4 General Indicators of Impacts of Climate Change on Local People

Climate change impacts could be direct or indirect, productive or destructive. Local people in the Tolon District, accept that these impacts affect all in various ways (Figure 4.11).

According to respondents, climate change has led to decline in forest resources (92%) as well as fuelwood (65%) (See figure 4.12). Respondents also indicate an increase in the incidence of hazards such as drought but not flooding. These observations reflect records of low rainfall in these areas which inadvertently has affected agricultural activities. There is low crop yield, which increases the risks of food scarcity and hunger.
Figure 4.12 Perceptions of Local People on the Indicators of Change in Climate

Source: Field Survey, 2015

There is the additional impact of coping with pests and diseases that affect crops and even livestock. A participant in a focus group discussion noted:

“…now we don’t get enough water, no firewood, it affects our livelihood” As we are sitting here, our problems are overwhelming. Even our lifespan has reduced. The way our grandparents used to live longer is no longer the case. Because the rain doesn’t fall, we don’t get enough food and water for our livelihood” (Yoggu-woman, FGD 2015).

4.5 Variations in Climate Change Impacts on Women and Men

The study sought to assess if climate change phenomenon affects women and men in the community differently. The study shows that the changes in climate do not affect women and men differently. Out of a total of 100 women, 96 women also concur that climate change does not affect people differently. Out of 150 men, a significant majority of 142 noted that climate change does not affect people differently (Figure 4.12). Climate change events
therefore affect all households in similar patterns however except for individual household strategies that mitigate the impacts of climate change are varied.

Figure 4.13 Perceptions on Differences in the Effects of Climate Change on Men and Women

Source: Field Survey, 2015
CHAPTER FIVE

ADAPTATION STRATEGIES AND ITS EFFECTS ON LIVELIHOODS AND ENVIRONMENT

5.1 Introduction

This chapter addresses issues on the various adaptation strategies used by female and male farmers and the effects on both livelihoods of farmers and the physical environment in the Tolon District. The chapter is sub-divided into three sections. The first section examines the adaption strategies that are used by male and female farmers in the district. The second determines how the adaptation strategies adopted affects the overall livelihood condition of respondents. Finally, the effect of the adopted strategies on the physical environment is assessed.

5.2 Climate Change Adaptation Strategies

The adoption of strategies to cope with climate change among farmers is a key consideration in nature-dependent farming communities. A Likert-scale measurement with assigned weights to the various adaptation strategies was used and the responses aggregated (Table 5.1). It was observed that increasing fertilizer use (10.8%) is the most adopted adaptation strategy towards climate change by farmers in the Tolon District. Farmers’ use of fertilizers as an adaptive strategy against climate change is due to two factors, the high crop yields and quick access to the fertilizer. In Kpalgun for instance, a farmer in the focus group discussion noted that,

“...some of the farmers belong to a union that provides them fertilizer on credit and payments are made after harvesting and selling the produce. This has increased access to fertilizer in our community”.

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Table 5.1: Adaptation Strategies of Farmers

<table>
<thead>
<tr>
<th>Adaptation Strategies</th>
<th>Frequencies</th>
<th>Percentages</th>
<th>Ranks</th>
</tr>
</thead>
<tbody>
<tr>
<td>planting different crop varieties</td>
<td>623</td>
<td>9.75</td>
<td>2nd</td>
</tr>
<tr>
<td>Increase fertilizer use</td>
<td>690</td>
<td>10.80</td>
<td>1st</td>
</tr>
<tr>
<td>Early and late planting</td>
<td>616</td>
<td>9.64</td>
<td>4th</td>
</tr>
<tr>
<td>planting trees</td>
<td>617</td>
<td>9.66</td>
<td>3rd</td>
</tr>
<tr>
<td>soil conservation</td>
<td>598</td>
<td>9.36</td>
<td>6th</td>
</tr>
<tr>
<td>water conservation</td>
<td>581</td>
<td>9.1</td>
<td>7th</td>
</tr>
<tr>
<td>alternative livelihood</td>
<td>435</td>
<td>6.81</td>
<td>11th</td>
</tr>
<tr>
<td>changing how harvesting is managed</td>
<td>566</td>
<td>8.86</td>
<td>8th</td>
</tr>
<tr>
<td>Market price</td>
<td>498</td>
<td>7.80</td>
<td>10th</td>
</tr>
<tr>
<td>changing livestock production</td>
<td>558</td>
<td>8.74</td>
<td>9th</td>
</tr>
<tr>
<td>Obtaining information on training</td>
<td>605</td>
<td>9.47</td>
<td>5th</td>
</tr>
<tr>
<td>Total</td>
<td>6387</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

Source: Field Data, 2016

Other adaptation strategies include planting different crop varieties (9.75%), planting trees (9.66%) and early and late planting (9.64) were 2nd, 3rd and 4th ranked adaptation strategies, respectively. Farmers explained that they have to engage in mixed farming rather than mono cropping, since different crops adjust to different climatic conditions. Farmers who engage in cattle rearing, mostly from Yogou and Kpaligun, allow their cattle to feed on grass in the farm all year round without planting. This was to encourage deposition of the animal dung to contribute to the richness of the soil. The animals are then moved away from the land the following year to allow for crop farming. Farmers also engage in an all year round planting of trees for purposes such as building material, storm breaks, source of income, among others. The 5th adaptation strategy was obtaining information on training (9.47%). Respondents sought for information from parents and extension officers on planting dates, weather
conditions and how to adapt to different crop varieties. The least adopted adaptation strategies included changing livestock production (8.74%), market price (7.8%) and alternative livelihood (6.81%), at 9th, 10th and 11th positions, respectively. These were not frequently adopted by farmers as adaptive strategies, especially with the alternative livelihood; most farmers strongly believed migrating to other regions for temporary jobs and engaging in some petty trading were strategies used only in years of unfavourable climatic conditions. In addition, there is a high level of livelihood strategy in the study communities coppled with both human and physical capital.

5.3 Adaptive Strategies Adopted by Female and Male Farmers

The study further sought to examine whether there are variations in the adaptation strategies adopted by female and male farmers in the Tolon district (Table 5.2) Generally, both female and male adopt all forms of strategies in their quest to overcome the challenges posed by changing climatic conditions. All men farmers plant crop varieties (100%), increase use of fertilizer (100%) and carry out early and late planting (100%), while 99% of female farmers adopt these same adaptive strategies. Almost all female farmers (99%) engage in planting trees, soil conservation, water conservation and changing how harvesting is managed (99%), as well as male (99.3%, 98.7%, 98.7% and 98% respectively), for the same adaptation strategies.

For female farmers, the least adopted strategies included alternative livelihood (94%), market price (92.7%) and changing livestock production (89%), compared to the male farmers - market price (90%), obtaining information on training (90%) and changing livestock production (82%). Although there are variations in the proportion of the adaptation strategies by female and male farmers, both female and male farmers in the Tolon district use similar adaptation strategies.
Table 5.2: Gender and Adaptation Strategies

<table>
<thead>
<tr>
<th>Adaptation Strategies</th>
<th>Male (%)</th>
<th>Female (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planting different crop varieties</td>
<td>100.0</td>
<td>99.0</td>
</tr>
<tr>
<td>Increase fertilizer use</td>
<td>100.0</td>
<td>99.0</td>
</tr>
<tr>
<td>Early and late planting</td>
<td>100.0</td>
<td>99.0</td>
</tr>
<tr>
<td>Planting trees</td>
<td>99.3</td>
<td>99.0</td>
</tr>
<tr>
<td>Soil conservation</td>
<td>98.7</td>
<td>99.0</td>
</tr>
<tr>
<td>Water conservation</td>
<td>98.7</td>
<td>99.0</td>
</tr>
<tr>
<td>Alternative livelihood</td>
<td>94.0</td>
<td>89.0</td>
</tr>
<tr>
<td>Changing how harvesting is managed</td>
<td>98.0</td>
<td>99.0</td>
</tr>
<tr>
<td>Market price</td>
<td>92.7</td>
<td>90.0</td>
</tr>
<tr>
<td>Changing livestock production</td>
<td>89.3</td>
<td>82.0</td>
</tr>
<tr>
<td>Obtaining information on training</td>
<td>94.7</td>
<td>90.0</td>
</tr>
</tbody>
</table>

Source: Field Data, 2016

HYPOTHESIS 2

The chi-square results of the relationship between gender and adaptation strategies in the Tolon District (Table 5.3) to assess significant relationships. The test results shows that the P-values of all variables were less than the test significance level of 0.05 except for gender and changing livestock production. Both men and women farmers will adopt any adaptation strategy and the adoption of a strategy does not depend on ones gender. On the other hand, with a chi-square value of 9.381 at a degree of freedom of 3 and a p-value of 0.025, the relationship between gender and livestock production is statistically significant. In other words, the adoption of livestock production as an adaptation strategy varies between both men and women.
Table 5.3: Chi-Square Test Results

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>CHI-SQUARE</th>
<th>INTERPRETATION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X^2-Value</td>
<td>Df</td>
</tr>
<tr>
<td>Gender * Different Crop Varieties</td>
<td>1.685</td>
<td>3</td>
</tr>
<tr>
<td>Gender* Increase Fertilizer use</td>
<td>2.409</td>
<td>3</td>
</tr>
<tr>
<td>Gender* Early and Late Planting</td>
<td>2.945</td>
<td>3</td>
</tr>
<tr>
<td>Gender * Planting Trees</td>
<td>3.153</td>
<td>3</td>
</tr>
<tr>
<td>Gender * Soil Conservation</td>
<td>1.658</td>
<td>3</td>
</tr>
<tr>
<td>Gender * Water Conservation</td>
<td>0.128</td>
<td>3</td>
</tr>
<tr>
<td>Gender * Alternative Livelihood</td>
<td>3.396</td>
<td>3</td>
</tr>
<tr>
<td>Gender * Changing how Harvest is Managed</td>
<td>6.448</td>
<td>3</td>
</tr>
<tr>
<td>Gender * Changing Market Practices</td>
<td>1.745</td>
<td>3</td>
</tr>
<tr>
<td>Gender * Changing Livestock Production</td>
<td>9.381</td>
<td>3</td>
</tr>
<tr>
<td>Gender * Obtaining more Information on Training</td>
<td>3.870</td>
<td>3</td>
</tr>
</tbody>
</table>

Source: Field Data, 2015  Significance Level – 0.05

5.4 Reasons for Adapting to Climate Change

Farmers adapt to climate change for varying reasons and perceived benefits. This section assesses the reasons for adapting to climate change by farmers in the Tolon District. There are rationales backing specific adaptation strategies that people choose in the events of climate change.

The reasons adduced by farmers were varied (Table 5.4). Male farmers noted that the main reasons for adopting an adaptation strategy was to support their families income base (21%), whereas the female counterparts cited the provision of food ingredients (18%), followed by: supporting their families (15.6%) different crops for a balanced diet (6%), men provided cereals (2.4%) and based on probability (0.4%) as the other reasons for adopting adaptation.
strategies. The male farmers, on the other hand, noted different crops for balance diet (10.8%), women provide soup ingredients (8%), based on probability (1.6%), and women cannot buy fertilizer (0.4%) as the reasons for adopting strategies against the changing climatic conditions.

<table>
<thead>
<tr>
<th>Reasons for adapting</th>
<th>Male (%)</th>
<th>Female (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Support family income</td>
<td>21.0</td>
<td>15.6</td>
</tr>
<tr>
<td>Different crop for balance diet</td>
<td>10.8</td>
<td>6.0</td>
</tr>
<tr>
<td>Because women provide soup ingredient</td>
<td>8.0</td>
<td>18.0</td>
</tr>
<tr>
<td>Because men provide cereal</td>
<td>2.0</td>
<td>2.4</td>
</tr>
<tr>
<td>Based on probability</td>
<td>1.6</td>
<td>0.4</td>
</tr>
<tr>
<td>Because women cannot buy fertilizer</td>
<td>0.4</td>
<td>-</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>44.8</strong></td>
<td><strong>42.4</strong></td>
</tr>
</tbody>
</table>

Source: Field Survey, 2015

Drought places limitations on local farmers in that, they are unable to plant varied species of plants that will enable them to have a balanced diet. In this regard, they adapt by finding means to cultivate various crop species under irrigation and fertilizer application techniques, as well as hybrid species that will enable them to cultivate albeit under the stressed climatic conditions. Moreover, indicating a high level of livelihood strategies. For both female and male farmers that choose probability as the reason for adopting strategies for climate change, they note that there was the probability of failed crop yields and hazardous events such as floods, extreme droughts and crop diseases.

In a focus group discussion, participants noted the following:

“..The adaptation now depends on rainfall; you have to get extra water through other sources. What I want you to understand is that it is not the fertilizer that is the solution to the problem, the water
remains very paramount. The preparation of the land, tilling and the rest is most challenging” (a Yoggu youth, FGD 2015).

“…When you grow the maize in small quantity and your husband gets fertilizer and the following year there is no money to buy the fertilizer you are likely to have low or no yield since there is no adequate rain. So sometimes because we don’t have enough money we grow groundnuts which don’t require the application of fertilizer. We also weed as well” (a woman from Fihini, FGD 2015).

“…We don’t have fertile lands to farm too. The men usually take the better ones before the other lands with low fertility are left for us” (Zagua-women, FGD 2015).

5.5 Differential Climate Change Impacts

In the light of the little variations noted in the adaptation strategies (Table 5.1) and the reasons adduced to the adoption (Table 5.2), the study sought to further examine if the climate change phenomenon affects females and males differently.

Figure 5.1 shows that the changes in climate do not affect people differently. Majority of farmers made up of female (38.4%) and male (56.8%) farmers responded ‘No’ to the question on whether climate change affects people differently. Although very few farmers still perceived some form of variations in the effect of climate change on gender, majority of respondents perceived otherwise.
5.6 The Effects of Adaptation Strategies on Livelihood of Farmers

The study further sought to assess the effects of the different adaptation strategies adopted on the livelihoods of female and male farmers. Variations in the positive effects on livelihoods were examined separately from the negative effects. Figure 5.3 indicates that for both female (28%) and male (42.8%) farmers, from their respective total numbers, the most positive effect of adaptation strategies on livelihood is the increased experience they have as a result of making different decisions to ensure sustainability in their livelihood conditions. The experiences of individual farmers revealed their strong social capital defined by DFID. The sharing of ideas and knowledge among them was a common practice. According to a female farmer,

“Whenever I have issues at my farm and living conditions I share that with my husband and some other friends. They are always of good help in sharing their own experiences from which I relate my own issues to make headway”.

Figure 5.1 Perceptions on Differential Effects of Climate Change on Men and Women

Source: Field Survey, 2015
Some male farmers also indicate that they have higher production (18%) in terms of yields through the use of improved seeds and access to fertilizer and other inputs. Examining the attitude of male farmers to access to improved seeds and fertilizer as well as other inputs, this explains strongly DFID’s social and physical capitals. They explained that, in most cases your ability to get access to improved seeds and other inputs depends on your social status in the community as well as your relation to the extension officers. According to a young farmer in the Fihini community,

“for me the extension officer is my friend and his dad is also my father’s friend. Anytime I call him for assistance, he is always ready if only the inputs are available. But it is not same for others. Access to these inputs could sometimes result in trade of insults and politics for several people”

Another farmer highlighting his access to physical capitals noted that:

“I am the eldest in my family, so I take control of the lands of my late father. For some of my sisters, I give them some of my produce as the land I gave them to farm is small. They don’t have the energy to cultivate on larger land area, so I still support them. For us men we do have easy access to land since we usually hold that title but it’s not same for the female”

In a separate discussion with female groups, a female discussant stated that:

“me, I have the strength to farm but I don’t have access to big land. What I have is just a small portion of my husband’s share. He told me that, farming is not my role to engage in and so I should just cultivate some staple foods for everyday use”
This view however was similarly supported another female farmer who further explained why her husband will not give her bigger land noting that:

“Even if he gives me a big land, I don’t have all the time to be on the farm. I do all the home chores and take care of food at all times. The little time may be to rest, so how can I manage a larger farm size with my limited time”

Similarly, females (12%) indicated increased production as they are more aware of climate change which encourages them to do extra work to earn higher outputs to support including during lean production periods. Most female farmers nevertheless were of the view that despite the small land sizes given them, they do their best to have higher returns on it through some intensive farming practices. Therefore indicating their livelihood outcome as in their respective communities.

![Figure 5.2 Positive Effects of Adaptation Strategies on Livelihood](source: Field Data, 2015)
Respondents also alluded that their food needs (Improved production, 12% female and 18% male) are relatively secured with the adoption of adaptation strategies like the use of fertilizer and improved seeds. They noted that their harvest is now more and thus are able to sell enough to raise money to get other household needs. Similar findings by Amikuzuno (2013) provide further evidence to the fact that the adoption of improved seeds and the use of fertilizer in farming have helped people in agrarian communities adapt effectively to climate change impacts. This partially has been noted to be a response of individual financial capitals defined by the DFID. Most farmers expressed full knowledge on the use of improved seeds but nonetheless questioned the difficulties in accessing such. They stated that you are either lucky to get some from the extension officers who we hardly see or meet in our part of the communities, so we usually have to get money and buy for ourselves. According to a one farmer at Yoggu, he explained that:

“I usually borrow from our community ‘Susu’ group and work hard so that I can return the money in good time. If not for this practice where we have to contribute to an elected person (mostly Queen Mother), mot have us will struggle to raise funds for our activities”

An analysis of the gender variations in the effect of adaptation strategy on livelihood reveal that both male (60.7%) and female (72%) farmers believed that reduced crop production was the major negative effect from the adaptation strategies (Figure 5.4). They explained that generally, the changes in the weather condition has affected their total crop yields and the adaptation strategies adopted only measures to ensure they at least have something to sustain them and their families. Also, both female (5%) and male (6%) farmers cited increasing poverty levels as another negative effect on their livelihood. They alluded to the fact that, difficulties they go through to put adequate food on the table for themselves and families has
made them closer to poverty. Some respondents are however of the view that adaptation strategies are not in its entirety beneficial, noting that the adoption of strategies such as the use of tractors to plough farms have reduced employment opportunities as less labour is now required instead of the traditional strategies where more labour is required.

Figure 5.3 Negative Effects of Adaptation Strategies on Livelihood

Source: Field Data, 2015

Key challenges that limit local people from actively engaging in many adaptation strategies include the lack of access to improved seeds, lack of irrigational facilities, and lack of current knowledge on adaptation methods. A respondent reported that;

“…First there is the issue of transportation, you know carrying the manure and what have you involved transportation. You will have to pay them; if there is no money you can’t transport. Next is with the fertilizer; you all know how expensive it is. If you don’t have money you can’t buy. Another is the earlier maturing varieties. The problem is the little drought can make them not to produce the expected output” (a man from Yoggu, FGD 2015).
5.7 Effects of Climate Change Adaptation Strategies on the Environment

In assessing the impact of adaptation strategies on the environment, factor analysis was used to ascertain the most pressing variable and its impact. The factors were isolated for respondents to indicate their perceptions on the impact of the adaptation strategies adopted on each of the environmental component. It shows the adaptation strategy and the component, component one gives the highest loadings impacts of the adaptation as compared to component two and two, also provides higher impact than three, in that order. The higher the value, the higher the impacts, (Tables 5.5 - 5.15) therefore in the various tables below the arrangements are in order of hierarchy, with selected explaining impacts on components.

5.7.1 Effects of Climate Change Adaptation Strategies on Soil

In analysing the impacts of adaptation strategies on soil, the components were grouped into three and the cumulative percentage more than half of the total percentage. In diminishing order, component one percentage of variance is 26.980%, component two, 19.426% , and three, 9.761%, and the cumulative percentage is 56.168 indicating that the components provide adequate information on the impact of the adaptation strategies on soil. The higher figures within the components signify higher impact (Table 5.5).
Table 5.5 Effects of Adaptation Strategies on Soil

<table>
<thead>
<tr>
<th>Adaptation Strategies</th>
<th>Component</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>63A-Impact of planting different varieties on soil</td>
<td>-.060</td>
</tr>
<tr>
<td>63B-Impact of increasing fertilizer use on soil</td>
<td>.658</td>
</tr>
<tr>
<td>63C-Early and late planting on soil</td>
<td>.199</td>
</tr>
<tr>
<td>63D-Impact of planting trees on soil</td>
<td>.654</td>
</tr>
<tr>
<td>63E-Impact of soil conservation on soil</td>
<td>.759</td>
</tr>
<tr>
<td>63F-Impact of water conservation on soil</td>
<td>-.018</td>
</tr>
<tr>
<td>63G-Impact of alternative livelihood on soil</td>
<td>.036</td>
</tr>
<tr>
<td>63H-Changing how harvest is managed on soil</td>
<td>.615</td>
</tr>
<tr>
<td>63I-Impact of changing market price on soil</td>
<td>-.025</td>
</tr>
<tr>
<td>63J-Impact of changing livestock production on soil</td>
<td>.449</td>
</tr>
<tr>
<td>63K-Impact of obtaining information or training on soil</td>
<td>.731</td>
</tr>
</tbody>
</table>

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 5 iterations.

Source: Field Work, 2016

The five strategies in component one, provide the greatest positive impacts on soil nutrition. Soil conservation is the most significant adaptation strategy in the communities that impacts the environment (.759) followed by obtaining information and training (.731) and changing how harvest is managed (.615) as the least impact (Table 5.6). These strategies provide positive impact on the environment because it helps the soil gain fertility for improved production to the benefit of the community members.
Table 5.6 Effectiveness of Adaptation Strategies on Soil

<table>
<thead>
<tr>
<th>ADAPTATION STRATEGY</th>
<th>COMPONENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>COMPONENT ONE</td>
<td></td>
</tr>
<tr>
<td>SOIL CONSERVATION</td>
<td>.759</td>
</tr>
<tr>
<td>OBTAINING INFORMATION AND TRAINING</td>
<td>.731</td>
</tr>
<tr>
<td>INCREASING FERTILIZER USE</td>
<td>.658</td>
</tr>
<tr>
<td>PLANTING TREES</td>
<td>.654</td>
</tr>
<tr>
<td>CHANGING HOW HARVEST IS MANAGED</td>
<td>.615</td>
</tr>
<tr>
<td>COMPONENT TWO</td>
<td></td>
</tr>
<tr>
<td>IMPACT OF ALTERNATIVE LIVELIHOODS</td>
<td>.795</td>
</tr>
<tr>
<td>IMPACT OF WATER CONSERVATION</td>
<td>.793</td>
</tr>
<tr>
<td>EARLY AND LATE PLANTING</td>
<td>.741</td>
</tr>
<tr>
<td>COMPONENT THREE</td>
<td></td>
</tr>
<tr>
<td>IMPACT OF PLANTING DIFFERENT VARIETIES ON SOIL</td>
<td>.892</td>
</tr>
</tbody>
</table>

Source: Field Data, 2015

For component two, three strategies provide greatest impacts on conserving soil moisture; changing how harvest is managed (.615), and water conservation with a loading of (.793). However, changing market price and changing livestock production has no impact on soil.

5.7.2 Effects of Climate Change Adaptation Strategies on Water

In assessing the impact of the adaptation strategies on water, four loadings explain the impact: component one variance is 30.189, component two 13.351, component three, 10.973 and four, .9124 variance, with a cumulative percentage of 63.636 (Table 5.7).
Table 5.7 Effects of Adaptation Strategies on Water

<table>
<thead>
<tr>
<th>Adaptation strategies</th>
<th>Component one loadings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Changing market price</td>
<td>.776</td>
</tr>
<tr>
<td>Soil conservation</td>
<td>.706</td>
</tr>
<tr>
<td>Early and late planting</td>
<td>.686</td>
</tr>
<tr>
<td>Changing how harvest is managed</td>
<td>.627</td>
</tr>
</tbody>
</table>

Source: Field Data, 2015

As shown in Table 5.8, changing market price has a higher impact on water (.776) as compared to changing how harvest is managed (.627), which is the least.

Table 5.8 Effect of Climate Change Adaptation Strategies on Water

<table>
<thead>
<tr>
<th>Adaptation strategies</th>
<th>Component one loadings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Changing market price</td>
<td>.776</td>
</tr>
<tr>
<td>Soil conservation</td>
<td>.706</td>
</tr>
<tr>
<td>Early and late planting</td>
<td>.686</td>
</tr>
<tr>
<td>Changing how harvest is managed</td>
<td>.627</td>
</tr>
</tbody>
</table>

Source: Field Survey, 2015
Component three indicates changing livestock production to be the highest adaptation strategy that impacts water in the environment (.828) and the least, obtaining information or training (.776) (Table 5.9).

The impact of obtaining information and training exerts more impact on water to the environment than that of planting different varieties on water to the environment but notwithstanding that obtaining information or training also has a higher impact on water to the environment than that of increasing fertilizer use and planting trees.

**Table 5.9 Effects of Adaptation Strategies on Water**

<table>
<thead>
<tr>
<th>Adaptation strategies</th>
<th>Component three loadings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Changing livestock production</td>
<td>.828</td>
</tr>
<tr>
<td>Impact of obtaining information or training</td>
<td>.776</td>
</tr>
</tbody>
</table>

Source: Field Survey, 2015

### 5.7.3 Effects of Climate Change Adaptation Strategies on Air

The impacts of adaptation strategies on air to the environment loaded four components. The first variance is 30.568% followed by 15.630%, 10.474% and 9.317 with a cumulative total of 65.989% (Table 5.10).
### Table 5.10 Effects of Adaptation Strategies on Air

<table>
<thead>
<tr>
<th>Component Matrix&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Component</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>63A3-Impact of planting different varieties on air</td>
<td>-.019</td>
<td>-.038</td>
<td>.926</td>
<td>.052</td>
</tr>
<tr>
<td>63B3-Impact of increasing fertilizer use on air</td>
<td>.468</td>
<td>-.504</td>
<td>-.128</td>
<td>-.295</td>
</tr>
<tr>
<td>63C3-Early and late planting on air</td>
<td>.345</td>
<td>.376</td>
<td>-.157</td>
<td>.748</td>
</tr>
<tr>
<td>63D3-Impact of planting trees on air</td>
<td>.714</td>
<td>.110</td>
<td>.109</td>
<td>-.091</td>
</tr>
<tr>
<td>63E3-Impact of soil conservation on air</td>
<td>.644</td>
<td>-.263</td>
<td>.317</td>
<td>.367</td>
</tr>
<tr>
<td>63F3-Impact of water conservation on air</td>
<td>.677</td>
<td>-.354</td>
<td>-.129</td>
<td>.167</td>
</tr>
<tr>
<td>63G3-Impact of alternative livelihood on air</td>
<td>.617</td>
<td>-.480</td>
<td>.072</td>
<td>-.027</td>
</tr>
<tr>
<td>63H3-Changing how harvest is managed on air</td>
<td>.694</td>
<td>.374</td>
<td>-.196</td>
<td>-.033</td>
</tr>
<tr>
<td>63I3-Impact of changing market price on air</td>
<td>.524</td>
<td>-.225</td>
<td>-.157</td>
<td>-.195</td>
</tr>
<tr>
<td>63J3-Impact of changing livestock production on air</td>
<td>.532</td>
<td>.628</td>
<td>-.003</td>
<td>-.163</td>
</tr>
<tr>
<td>63K3-Impact of obtaining information or training on air</td>
<td>.471</td>
<td>.548</td>
<td>.238</td>
<td>-.372</td>
</tr>
</tbody>
</table>

Extraction Method: Principal Component Analysis.

<sup>a</sup> 4 components extracted.

Source: Field Data, 2015

Table 5.11 provide further explanations to these strategies.

### Table 5.11 Factor Analysis of Adaptation Strategies

<table>
<thead>
<tr>
<th>Adaptation strategies</th>
<th>Component one loadings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alternative livelihood</td>
<td>.773</td>
</tr>
<tr>
<td>Water conservation</td>
<td>.735</td>
</tr>
<tr>
<td>Increasing fertilizer use</td>
<td>.712</td>
</tr>
<tr>
<td>Soil conservation</td>
<td>.603</td>
</tr>
</tbody>
</table>

Source: Field Data, 2015
From the information obtained from factor analysis, alternative livelihood (.773) indicates a greater impact on air as compared to the others including the least loading, i.e., soil conservation (.603). However, soil conservation has a higher impact on air when compared to the highest loadings in component two (Figure 5.12). The least loading in component two, changing how harvest is managed (.671) has more impacts than early and late planting (.897) of component three, and planting of different varieties (.923) in component four.

**Table 5.12: Factor Analysis Component Two Loadings**

<table>
<thead>
<tr>
<th>Adaptation strategies</th>
<th>Component two loadings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Obtaining information or training</td>
<td>.826</td>
</tr>
<tr>
<td>Changing livestock production</td>
<td>.821</td>
</tr>
<tr>
<td>Changing how harvest is managed</td>
<td>.671</td>
</tr>
</tbody>
</table>

Source: Field Data, 2015

5.7.4 Effects of Climate Change Adaptation Strategies on Biodiversity

The variance of the components for the impacts of climate strategies on biodiversity are 39.655, 13.026, and 9.811 of components one, two and three, respectively, with a cumulative total of 62.491 (Table 5.13).
Table 5.13 Effects of Climate Change Adaptation Strategies on Biodiversity

<table>
<thead>
<tr>
<th>Vegetation and biodiversity</th>
<th>Rotated Component Matrix&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Component</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>63A4-Impact of planting different varieties on vegetation and biodiversity</td>
<td></td>
<td>1</td>
<td>.048</td>
<td>.010</td>
<td>.953</td>
</tr>
<tr>
<td>63B4-Impact of increasing fertilizer use on vegetation and biodiversity</td>
<td></td>
<td>2</td>
<td>.795</td>
<td>.262</td>
<td>.147</td>
</tr>
<tr>
<td>63C4-Early and late planting on vegetation and biodiversity</td>
<td></td>
<td>3</td>
<td>.721</td>
<td>.139</td>
<td>-.088</td>
</tr>
<tr>
<td>63D4-Impact of planting trees on vegetation and biodiversity</td>
<td></td>
<td></td>
<td>.778</td>
<td>.373</td>
<td>-.148</td>
</tr>
<tr>
<td>63E4-Impact of soil conservation on vegetation and biodiversity</td>
<td></td>
<td></td>
<td>.375</td>
<td>.621</td>
<td>.036</td>
</tr>
<tr>
<td>63F4-Impact of water conservation on vegetation and biodiversity</td>
<td></td>
<td></td>
<td>.369</td>
<td>.600</td>
<td>-.355</td>
</tr>
<tr>
<td>63G4-Impact of alternative livelihood on vegetation and biodiversity</td>
<td></td>
<td></td>
<td>-.002</td>
<td>.797</td>
<td>-.106</td>
</tr>
<tr>
<td>63H4-Changing how harvest is managed on vegetation and biodiversity</td>
<td></td>
<td></td>
<td>.712</td>
<td>-.044</td>
<td>-.006</td>
</tr>
<tr>
<td>63I4-Impact of changing market price on vegetation and biodiversity</td>
<td></td>
<td></td>
<td>.026</td>
<td>.719</td>
<td>.120</td>
</tr>
<tr>
<td>63J4-Impact of changing livestock production on vegetation and biodiversity</td>
<td></td>
<td></td>
<td>.353</td>
<td>.544</td>
<td>-.002</td>
</tr>
<tr>
<td>63K4-Impact of obtaining information or training on vegetation and biodiversity</td>
<td></td>
<td></td>
<td>.785</td>
<td>.189</td>
<td>-.131</td>
</tr>
</tbody>
</table>

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

<sup>a</sup> Rotation converged in 4 iterations.

Source: Field Data, 2015

The type of strategies and their respective loading are shown in Table 5.14. The five strategies in component one indicates a higher impact of these strategies on vegetation and biodiversity to the environment. The greatest strategy in is increasing fertilizer use (.792).
Table 5.14 Factor Analysis Component One Loadings

<table>
<thead>
<tr>
<th>Adaptation strategies</th>
<th>Components one loadings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increasing fertilizer use</td>
<td>.795</td>
</tr>
<tr>
<td>Obtaining information and training</td>
<td>.785</td>
</tr>
<tr>
<td>Planting trees</td>
<td>.778</td>
</tr>
<tr>
<td>Early and late planting</td>
<td>.721</td>
</tr>
<tr>
<td>Changing how harvest is managed</td>
<td>.721</td>
</tr>
</tbody>
</table>

Source: Field Data, 2015

Alternative livelihood has a higher impact on vegetation and biodiversity to the environment (.797) as compared to water conservation (.600) of component two (Table 5.15), followed by planting different varieties (.953) in component three, and livestock production.

Table 5.15 Factor Analysis Component Two Loadings

<table>
<thead>
<tr>
<th>Adaptation strategies</th>
<th>Component two loadings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alternative livelihood</td>
<td>.797</td>
</tr>
<tr>
<td>Changing market price</td>
<td>.719</td>
</tr>
<tr>
<td>Soil conservation</td>
<td>.621</td>
</tr>
<tr>
<td>Water conservation</td>
<td>.600</td>
</tr>
</tbody>
</table>

Source: Field Data, 2015
CHAPTER SIX
SUMMARY OF KEY FINDINGS, CONCLUSION, AND RECOMMENDATIONS

6.0 Introduction

This chapter summarizes the key findings of the study, and conclusions and recommendations based on the findings of the study. The summary is discussed under sub-themes generated from the objectives, followed by the conclusion and recommendations.

6.1 Summary of Findings

The section provides a summary of the key findings from the study.

6.1.1 Perceptions of Female and Male Farmers on Climate Change

Analysis of the climatic data from Ghana Meteorological Agency reveals that climatic conditions in the Tolon district over the last 30 years have increasingly changed. Whereas temperature has recorded an increasing trend, rainfall on the other hand has been decreasing, for the period 1985-2015 under study. The study further found out that both female and male farmers were highly aware of the changing climate across all communities under study. Respondents based their experiences on the long period they had lived in their communities, knowledge passed on from generations to them and information provided by extension officers, to determine changing climatic conditions.

Gender variations in the perception of climate change, however, showed that both female and male farmers could report changing temperatures and rainfall intensity. For temperature, of 97% female and 98% male respondents farmers noted increasing temperatures. For rainfall, 99% female farmers and 100% male farmers indicated a decreasing intensity of the amount of received in the district.
6.1.2 Effects of Climate Change on Livelihood of Female and Male Farmer

Further, the study found out that both men and women primarily engage in farming as the major livelihood occupation. All respondents, 58.8% males and 38.3% females, noted that climate change was affecting various aspects of their livelihoods. Many ecosystem based activities are climate dependent. Communities who continually depend on such ecosystem based activities are rendered more vulnerable to the impacts of climate change. Most livelihood activities in the Tolon district however heavily rely on climate thereby making the residents more vulnerable to climate change effects. They indicated the reduction in crop production, negative effects on business, reduction in livestock production and changing farming methods as some notable impacts on livelihoods. Gender variations, however, showed that male farmers noted reduction in livestock production (25.2%), negative effect on business (17.2%) and reduction in crop production (16.8%) as leading effects on livelihoods, whereas the female farmers noted negative effect on business (14.8%), reduction on livestock production (14.4%) and reduction in crop production (10.8%) as leading effects. Both male and female farmers relied on these ecosystem based activities for their livelihood with very insignificant differences of impacts felt by male and female residents.

6.1.3 Adaptation Strategies Adopted by Female and Male Farmers

The study on the adaptation strategies also revealed that farmers mostly adopt increased use of fertilizer (10.8%), plant different crop varieties (9.75%), plant trees (9.66%), plant early and late (9.64%) and obtain information on training as the leading adopted adaptation strategies. Gender variations, however, revealed that both female and male respondents adopted all forms of strategies with the variations only shown in the order of adoption and intensity of use of the strategy.
6.1.4 Effects of Adaptation Strategies on the Physical Environment

The study examined the impacts of the adaptation strategies on the environment. The study revealed that soil conservation with loading of .759, obtaining information (.731) and increasing fertiliser use (.659) has the most impact on soil. For water as another environmental resource, the study showed that changing market price had the highest loading with .776 points, with soil conservation (.706), early and late planting (.686) constituted the highest scoring strategies on the first loading component. These therefore have the most significant effects on water. Similarly, the adaptation strategies on air also showed that alternative livelihood (.773), water conservation (.735), increasing fertilizer use (.712) and soil conservation (.602) had the most significant effects on air. Finally, the adaptation strategy with the greatest impact on biodiversity was the increasing fertiliser use with a factor loading of .795. The other significant strategies with impacts on biodiversity included obtaining information on training (.785), planting trees (.778), early and late planting (.721) and changing how harvest is managed (.712).

6.2 Conclusion

The study sought to examine the perceptions of male and female farmers on climate change variability, adaptation strategies towards mitigating the effects of climate change and the effects of the adopted strategies on livelihood and the physical environment. Climate change has been a major phenomenon receiving much attention from academicians and professionals across the globe. With the huge volume of knowledge existing on climate change and its effects, there was the need to disaggregate various elements for targeted policy interventions. In Ghana, availability of climatic data have surged the awareness on the social, economic and environmental impacts of climate change. Gender dimensions on the impacts of climate change.
change however are lacking for targeted interventions. The study results present strong cases for consideration by policy makers in implementing effective policies towards reducing the impacts of climate change on livelihoods and the environment especially by given attention to ecosystem based resources affected by climate change impacts.

6.3 Recommendation

In the light of the study findings, the following recommendations have been forwarded for consideration by all stakeholders including policy makers and MDA’s.

1. The high level of awareness on climate change needs to be sustained and among younger generations. Extension officers should be continually supported to continue their awareness creations at the local level whiles inculcating sustaining the traditional way of passing on knowledge and information to the younger generations.

2. With both men and women engaging in agriculture as their primary occupation, government’s policy on distribution of inputs such as fertilizers ploughs and others should be made equally accessible to both female and male farmers. The MDA’s must take keen interest in monitoring the distribution of such inputs while making sure both men and women have equal and easy access.

3. The adaptation strategies adopted by female and male farmers needs to be supported and improved to increase output of farmers to ensure food security while protecting the available resources. The fight against climate change however is a collective responsibility that must include both female and male farmers to achieve global sustainable climate change. Whiles government and policy makers continue to mitigate climate change on a sustainable path, there is the need to support and protect the environment through more ecosystem based adaptations. Extension officers
should closely work with community members and provide knowledge and directives for the use of fertilizers, tree cutting, water resources, livestock production among various specific practices in that ecological zone.

4. The study finally recommends that, the Local Assembly should take charge in the protection of the environment by enacting various by laws on the protection of environmental resources, whiles supporting such local activities as tree planting and water and soil conservation strategies.
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APPENDIXES

QUESTIONNAIRE

Name of respondent       Gender

Town/district             Date

Demographic Questions

1. What is your age?
   a. [ ] 25 or under  b. [ ] 26-40   c. [ ] 41-55   d. [ ] 56 or older

2. Gender
   a. [ ] Female  b. [ ] Male

3. What is your level of education?
   a. [ ] None       b. [ ] Primary       c. [ ] J.S.S.       d. [ ] S.H.S.
   e. [ ] Tertiary       f. [ ] Other ............

4. What is your current marital status?
   a. [ ] Divorced       b. [ ] Married #...........       c. [ ] Separated
   d. [ ] Single       e. [ ] Widowed

5. What is the number of your male dependents?
   a. [ ] Under 5       b. [ ] 6-10       c. [ ] 11-15       d. [ ] 16-20
   e. [ ] Above 30

6. What is the number of your female dependents? a. [ ] under 5  b. [ ] 6-10  c. [ ] 11-15  d. [ ] 16-20  e. [ ] Above 30

7. How long have you stayed in this community? a. [ ] Less than 9 years  b. [ ] 10-19 years  c. [ ] 20-29 years  d. [ ] 30-39 years  e. [ ] > 40 years  f. [ ] All my life

8. If not all your life, where did you come from?

9. Why did you move to this community?

10. What is your local dialect? a. [ ] Dabani  b. [ ] Hausa  c. [ ] Mamprusi
d. [ ] Twi  e. [ ] Gonja  g. [ ] Other ............

11. What kind of assets do you personally have?
    a. [ ] Cattle  b. [ ] Sheep  c. [ ] Goat
d. [ ] Chickens  e. [ ] Guinea fowls  f. [ ] Television set
g. [ ] Radio  h. [ ] Fridge  i. [ ] Other

 .......................
12. What is your occupation?
   a. [ ] Homemaker    b. [ ] Student
   c. [ ] Unemployed    d. [ ] Retired   e. [ ] Farming
   f. [ ] Petty trading g. [ ] Other …………………

13. What are your other sources of income, e.g., family support, etc.?

14. What is your religious affiliation?
   a. [ ] Islamic religion b. [ ] Christianity  c. [ ] Traditional religion
   d. [ ] None    d. [ ] Other…………………………..

15. What are your responsibilities in the household?

16. What kind of decisions do you make about food issues in your household?

17. What are your major agricultural activities (e.g., crop production, sowing, harvesting, ploughing, livestock, processing, etc)

18. Do you belong to any social group?   a. [ ] Yes    b. [ ] No
   If yes, which one/s?

19. What is the role of the group/s?

20. Do you benefit from being part of this group?
   a. [ ] Yes    b. [ ] No    c. [ ] Don’t know
   If yes, how?

21. Is there any one that cannot be a member of this group?
   a. [ ] Yes    b. [ ] No    c. [ ] Don’t know
   If yes, who and why not?

**Respondent’s perception of climate change**

*Use the following to rank your perception on changes in temperature and rainfall in the past years.*

<table>
<thead>
<tr>
<th>Weather</th>
<th>Gender</th>
<th>Rank</th>
<th>Since when?</th>
</tr>
</thead>
<tbody>
<tr>
<td>22.</td>
<td>Temperature</td>
<td></td>
<td></td>
</tr>
<tr>
<td>23.</td>
<td>Precipitation</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
24. If there are changes, have these changes affected your livelihood?
   a. [ ] Yes   b. [ ] No   c. [ ] Don’t know

   If yes, how?

25. If there are changes, have these changes affected your household?
   a. [ ] Yes   b. [ ] No   c. [ ] Don’t know

   If yes, how?

26. Do you think these changes affect some people in your household more than others?
   a. [ ] Yes   b. [ ] No   c. [ ] Don’t know

   If yes, who, and why?

27. Have you heard about climate change?  a. [ ] Yes   b. [ ] No   c. [ ] Don’t know

   If yes, how do you understand climate change?

   Kindly use the options below to answer the following questions according to your level of agreement or disagreement

28. Have the changes in climate resulted in any of the following?

<table>
<thead>
<tr>
<th>Impact</th>
<th>Agree</th>
<th>Strongly Agree</th>
<th>Disagree</th>
<th>Strongly disagree</th>
<th>Don’t know</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel wood scarcity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Decline of forest resources</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Higher incidence of floods</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Higher incidence of droughts</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poor soil fertility</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reduced crop yield</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increased crop infestation and disease</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reduced water resources</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Impacts on livestock</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other........................................</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other........................................</td>
<td></td>
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</tbody>
</table>
29. Have you personally ever been affected by any extreme climate events (e.g., strong winds, heavy rainfall, flood, drought, etc.)?  
   a. [ ] Yes  
   b. [ ] No  
   c. [ ] Don’t know  
   If yes, what was the event?

30. How did it affect you or your food supply?

31. How did you respond to it (e.g. alternative livelihood, change farming practice, etc)?

32. Did you prepare yourself to prevent impacts from the next event?  
   a. [ ] Yes  
   b. [ ] No  

33. If yes, was your response effective?  
   a. [ ] Yes  
   b. [ ] No  
   c. [ ] Don’t know  
   Why or why not?

To determine the difference in men and women adaptive strategies as small holder farmers

34. Do men and women in your community have different adaptive strategies to deal with the changes in the climate?  
   a. [ ] Yes  
   b. [ ] No  
   c. [ ] Don’t know

35. If yes, why do they do things differently?

36. Which of the following adaptation strategies do you use and how effective is it for you?

<table>
<thead>
<tr>
<th>Adaptation strategy</th>
<th>Effectiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
</tr>
<tr>
<td>Planting different crop varieties</td>
<td></td>
</tr>
<tr>
<td>Increasing fertilizer use</td>
<td></td>
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<tr>
<td>Early and late planting</td>
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<tr>
<td>Planting trees</td>
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</tr>
<tr>
<td>Soil conservation</td>
<td></td>
</tr>
<tr>
<td>Water conservation</td>
<td></td>
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<tr>
<td>Alternative livelihoods</td>
<td></td>
</tr>
<tr>
<td>Changing how harvest in managed</td>
<td></td>
</tr>
</tbody>
</table>
37. Who decides on the adaptation strategy to use?

38. In addition to the changes in the climate, what other reasons influenced you to take these decisions (e.g., you were trained by a group; your family has always been doing this, etc)?

39. What information was needed to decide on which strategy to implement?

40. Who provided this information (e.g., extension officers, friends, chief, teacher, etc)?

41. Was this information shared in your household?  
   a. [ ] Yes  b. [ ] No

   If no, why not?

   Investigate the effectiveness of adaptive strategies in terms of improvement of livelihoods

42. How do the adaptation strategies affect your livelihood?
   [ ] If positively, explain…………………………………………………………………………………………
   [ ] If negatively, explain…………………………………………………………………………………………

43. How do the adaptation strategies affect your income level?
44. How do the adaptation strategies influence your employment?
45. How has your household food security been influenced by the adaptation strategy?
46. What do you think are some barriers for you in using modern techniques for adaptation?
   (a) [ ] Lack of improved seeds
   (b) [ ] Lack of access to water for irrigation farming
   (c) [ ] Lack of current knowledge on adaptation methods
   (d) [ ] Lack of information on weather incidence
   (e) [ ] Lack of money to acquired modern techniques
   (f) [ ] There is no hindrance to adaptation
   (g) [ ] Other…………………………………………………………………………………………

47. What do you recommend to be done that will enhance the fight towards climate change?  
   Comment freely.
To understand if men and women feel that their actions are positively or negatively impacting the environment

48. What are some of the resources in your environment that are important for you (including medicinal herbs, small animals, birds, etc)?

49. Who makes decisions about who can use land, water and other important resources, women or men?
50. Who collects water for the household?
51. How long does it take
52. Where do you get your firewood from?
53. Who collects it?
54. How long does it take?
55. Which method is used to collect these (e.g., on foot, bicycle, etc)?
56. Where are animals taken for grazing?
57. Who manages the grazing?
58. How long does it take?
59. Are there any conflicts over use of resources?
If yes, why?
60. Who is affected by these conflicts?
61. With the adaptation strategies described earlier, do any affect the environment positively?
If yes, which and how?
62. Are there any adaptation strategies that affects the environment negatively, if yes which and how?

63. How do adaptation strategies impact on the following environmental parameters?

a. [ ] Low  b. [ ] somehow low  c. [ ] moderate  d. [ ] high  e. [ ] very high  f. [ ] other

<table>
<thead>
<tr>
<th>Adaptation strategy</th>
<th>Impacts on Environmental Quality</th>
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<tbody>
<tr>
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<td>Soil</td>
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Overview: Each PRA will be composed of a moderator; a note taker; and 6-10 participants. Separate groups will be held for men and women. The role of the moderator is to conduct the flow of the PRA activities and conversations; to engage with participants; and to maintain the flipchart or PRA activity materials while guiding the flow of conversation. The role of the note taker is to take down bullet point notes on the key questions, activities or conversations that transpire. If possible, record (audio) the event.

Introduction

- Greetings, introduction of the team and the project
- Explanation of the program and participant list
- Group formation (men and women)
- Please take down the following information about each participant: name, age, education level, gender, household head (y/n)

Tool 1: Community Climate History and Adaptive Strategies

Objectives: The objective of the climate history is to understand community perceptions of how and why climate has changed over the course of their lifetime and understand what people have done to adapt.

Materials: Flip chart, index cards, large pieces of paper, markers, stickers

Activities: Moderator works with PRA participants to identify “signs” of long-term climate change. Participants write different “signs” on index cards; the facilitator pastes them vertically on the left side of the flipchart. Group participants discuss each “sign” moving horizontally from one column to the next (each column is a different flipchart sheet), addressing information, impacts, adaptations, constraints, and resources (see below).

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<th>Sign</th>
<th>Information</th>
<th>Impacts</th>
<th>Adaptation</th>
<th>What is needed</th>
<th>Constraints</th>
<th>Resources</th>
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(Moderator set up the issues discussed in this section: I want you to think back to a long time ago when you were much younger and I want to ask some questions about how the climate was different in your community back then. For those of you who were quite young, you should think back to your childhood and you may want to reference what your parents or grandparents have told you about the climate in the past.)

Key questions:

- **Signs:** During your lifetime, have you noticed any changes in climate?
Prompt:
What changes have you observed? (Prompt participants to write changes or “signs” of climate change on index cards.)
Do you think these changes are temporary or permanent?

- **Information**: Where do you get your information about these changes in climate? (Responses may be listed on a separate flipchart.)

Prompt:
What are the most important sources of information? (Use stickers to score the three most important sources)
How reliable are these sources of information? (Rank 1-3, with 1 being the most reliable)

- **Impacts**: How does this change in climate affect you and your community?

Prompt:
Your environment
Your household
Your community

**Adaptations**: What can be done to address or adapt to these changes? (Rank which are the most important measures to adapt to climate change 1-3 with 3 being the most important)

Prompt:
How is that done?
Who does it?
At what level (household, community, district, national)?

- **Constraints**: What stands in the way of adapting to the changes in climate?

Prompt:
How big (difficult to address) are those barriers?

Which are the 3 most difficult barriers to overcome? (Ask participants to rank responses 1-3 using stickers, 1 being the most difficult)

- **Resources**: What tools, resources, information, interventions are needed to do adapt or overcome any barriers?

Prompt:
At what time are the resources, information, or interventions needed?
Who has those resources or information, who decides about those interventions?

**Tool 2: Group-based approaches to adaptation**

**Objectives**: To understand the types of groups operating in the community. By groups we refer to an organized body of community members formed for a purpose, for example a burial
group, a savings group, a women’s group and so on. Some groups include only women or only men or youth, and some groups are mixed.

**Materials:** Flip chart, index cards, large pieces of paper, markers, stickers

**Activities:** The moderator works with participants to identify groups in the community that help people cope with or adapt to climate change either directly or indirectly. The moderator first asks participants to brainstorm on the groups/organizations in the community and write these on index cards. The name of each organization will be written at the top of its own large sheet of paper (each organization is a different flipchart sheet). Participants then discuss each group/organization moving vertically through each of the topics—origins, purpose, activities/beneficiaries, membership/participation, effectiveness, and link to climate change adaptation (see below).

<table>
<thead>
<tr>
<th>Organization/group</th>
<th>Group 1</th>
<th>Group 2</th>
<th>Group 3</th>
<th>Group 4</th>
<th>Group 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Origin</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Purpose/objectives</td>
<td></td>
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<tr>
<td>Activities/beneficiaries</td>
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<td></td>
<td></td>
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<tr>
<td>Membership/participation</td>
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<tr>
<td>Effectiveness</td>
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<tr>
<td>Link to adaptation</td>
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</tbody>
</table>

**Key questions:**

- **Organizations:** What are the most important groups or organizations in the village? *(Participants list on index cards and note taker records these at the top of separate sheets of paper. Ask participants (still separated into men’s and women’s and potentially a youth group) to rank the 3 most important groups for their purposes in the village from 1-3 using stickers, with 1 being the most important)*

  **Prompt:**
  Think of groups that directly or indirectly focus on reducing poverty, enhancing assets, reducing risk, and/or adapting to climate change
  For those groups ranked most important, what was the reason for the ranking?

  *(For each organization, moderator leads discussion of the topics below while note taker records responses on the large sheets of paper)*

- **Origin:** How did this group form?

  **Prompt:**
Who initiated/founded the group?
When was the group initiated/founded?
Why was the group initiated? [was there a particular event that led to formation e.g. tie back to earlier discussions about shocks if applicable]

- **Objectives/purpose**: What are the main objectives or purpose of the group?

- **Activities**: Which activities does this group undertake?

  **Prompt**: Who benefits from these activities?

- **Membership/participation**: Who are members of the group?

  **Prompt**
  How many members does the group have?
  What is the composition in terms of gender, age, etc.?
  How does one qualify to join the group? (i.e. membership criteria)
  Are certain people prevented from joining?
  How often, where and when do groups meet? Are there provisions for child care?
  How are decisions made within the group? (e.g. democratic consensus, village chief, etc.)

- **Effectiveness**: How effective is the group at meeting its objectives?

  **Prompt**
  What are the strengths of the organization? (e.g. assets, resources, support, organizational capacity, etc.) constraint

- **Adaptation**: How do you think this organization/group helps the community cope with or adapt to the climate changes discussed earlier?

  **Prompt**
  Is this group helpful in coping with or adapting to climate changes?
  How does this group support adaptation?

  *Rank from 1-3 which are the most important ways the group helps the community adapt to climate change, with 1 being the most important*

  What constraints does it face? (e.g. resources, internal conflicts, external support etc.)

  *Rank strengths and constraints on a scale from 1-3, 1 being the greatest strength or biggest*